MINES AND MINERAL DEPOSITS (EXCEPT FUELS) JUDITH BASIN COUNTY, MONT.

BY ALMON F. ROBERTSON AND ROBERT N. ROBY

* * * * * * * * * * **Information Circular 7602**

UNITED STATES DEPARTMENT OF THE INTERIOR
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Almon F. Robertson and Robert N. Roby[1/]

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1/ Mining engineers, Bureau of Mines, Minerals Division, Region II.

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INTRODUCTION AND SUMMARY

This is one of a series of reports describing investigations made within the Missouri River Basin in Montana by mining engineers of the Bureau of Mines, Minerals Division, Region II. The primary purpose of these investigations is to provide basic information to agencies of the Department of the Interior and other agencies concerned with the planning of power and other water developments in the Missouri River Basin. This report contains only such factual data as have been authorized for public distribution. Special precautions have been taken not to reveal any information or data considered to be confidential.

The field investigations for this report were made during the fall of 1948 and the summer of 1949. Virtually all of the known metallic mineral deposits and some nonmetallic (industrial) mineral deposits within Judith Basin County were investigated. Most of the mines and prospects have been inactive for many years; most of the old underground mine workings now are inaccessible or only partly accessible. Consequently, much of the information on many of the mines and prospects necessarily has been obtained from available U. S. Government and State publications and from owners and local residents.

Judith Basin County in Montana was created in December 1920 from parts of Cascade and Fergus Counties. The known metallic-mineral deposits are confined mainly to the Barker, Running Wolf, Yogo, and San Miguel districts in the western part of the county. Most of the known metallic mineral deposits have been worked intermittently only, generally on a small scale; many have been productive of relatively small amounts of ore. The outstanding producer has been the Block P mine in the Barker district; it is credited with about 95 percent of the county's metal output since 1920. Since 1943, only a few small operations have been active; they were conducted by claim owners or lessees.

From 1921 to 1948, inclusive, the mines in Judith Basin County have made a recorded production of gold, silver, copper, lead, and zinc valued at $5,946,294, in terms of recovered metal. No segregated production records prior to 1921 are available. It is known, however, that the mines produced important tonnages of high-grade silver-lead ores and some gold and copper ores before 1921.

Placer gold was discovered in Yogo Gulch about 1865, but the prospectors were driven away by hostile Indians. Gold placer mining was resumed, however, in Yogo Gulch in 1879, but most of these small-scale operations soon were abandoned when rich silver-lead deposits were discovered in the Barker area in October 1879.

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The silver-lead deposits in the Barker area soon became important producers. Large quantities of high-grade ores reportedly were mined and hauled to Fort Benton on the Missouri River and shipped from there by river steamboats to distant smelters. Smelters were erected at Barker (Clendennin) and Hughesville but were operated for a short time only. Mining in the Barker district waned with the depletion of the rich, near-surface, argentiferous, lead carbonate ore bodies. Deeper development penetrated lower-grade, more basic ore that could not be mined and shipped profitably at that time. Several of the larger mines resumed operations when a branch line of the Great Northern Railroad reached Barker in 1891. The demonitization of silver in 1892 forced most of the mines to close.

The St. Joseph Lead Co. acquired the Block P group of claims in the Barker district in 1927. This company did extensive development, constructed a 400-ton selective-flotation plant, and operated continuously until September 1930. The mine remained idle until 1941, when the company resumed operations, which continued until October 1943.

Sapphire was discovered in a gold placer deposit near Yogo Gulch in 1895. In 1896 the source of the sapphire was discovered to be a nearby basic dike. This dike was mined from 1897 to 1929. Total sapphire production is estimated to have been about 16,000,000 carats in weight, of which about 15 percent was of gem quality; the balance was mainly industrial grade. The value of the uncut gem-quality stones was about $2,500,000; their value after cutting has been estimated at $20,000,000 to $30,000,000.

Gypsum was mined and processed to plaster in the vicinity of Kibbey many years ago. Some limestone was quarried years ago for use as flux at a small smelter and for lime production for local use only. The extensive bentonite deposits within the county have not been exploited.

ACKNOWLEDGMENTS

Compilation of this report was aided materially by cooperation of the numerous mine and claim owners; their assistance is gratefully acknowledged.

Information concerning their respective activities, as related to the mining industry within Judith Basin County, was provided by officials of the Anaconda Copper Mining Co., the American Smelting & Refining Co., the Montana Power Co., and the Great Northern Railroad.

Statistical information was provided by the Economics and Statistics Division, Bureau of Mines, Salt Lake City, Utah. Climatological data were supplied by the U. S. Weather Bureau, Helena, Mont.

Reports and unpublished manuscripts by the U. S. Bureau of Mines, the U. S. Geological Survey, the Montana State Bureau of Mines and Geology, and numerous individuals have provided much valuable information. Sources of information are referred to in the body of the text by numbers in parentheses, which correspond to numbers of references given at the end of the report.

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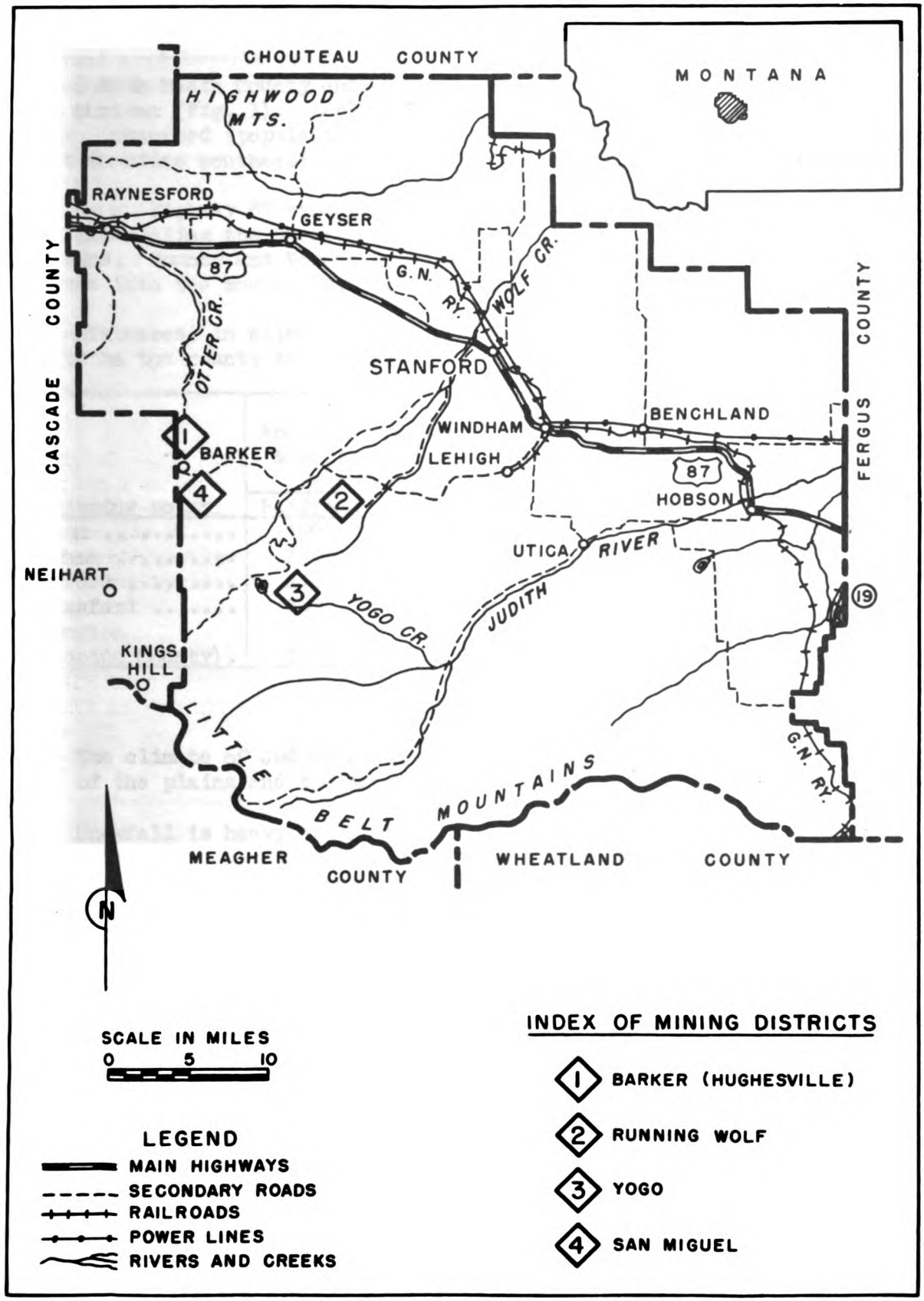

Figure 1.— Index map, Judith Basin County, Mont.

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LOCATION AND ACCESSIBILITY

Judith Basin County embraces an area of 1,860 square miles in central Montana (fig. 1). According to the 1940 census, the population was 3,655. Stanford (population 529), the county seat and largest town, is about 60 miles southeast of Great Falls, Mont.

U. S. Highway 87 traverses the county from east to west, more or less paralleling the Great Falls-Billings branch of the Great Northern Railroad. County and Forest Service roads, which generally follow stream courses into the mountains, serve the mining districts.

Distances, in miles, by rail and highway between the main shipping points in the county and the smelters in Montana are as follows:

Shipping point	American Smelting & Refining Co., East Helena		Anaconda Copper Mining Co., Washoe sampler, Butte		Anaconda Copper Mining Co. zinc plant, Great Falls	
	Railroad	Highway	Railroad	Highway	Railroad	Highway
Hobson	196	187	263	248	95	91
Windham	179	171	246	232	78	75
Stanford	172	160	239	222	71	65
Raynesford	143	135	210	196	42	39
Armington (Cascade County).	132	123	199	184	31	27

CLIMATE

The climate of Judith Basin County in general is semiarid. The climate of the plains and the mountainous areas differs markedly.

Snowfall is heavy at the higher altitudes. Roads leading to the mining districts usually are not kept open in winter. In the Barker district the snowfall is not excessive; the road from Monarch (Cascade County) is kept open throughout the winter. Many of the mines in this district have been operated throughout the year.

Indicated climatological data at stations within and adjacent to Judith Basin County, as compiled from records provided by the U. S. Weather Bureau, Helena, Mont., are given in tables 1 and 2.

TOPOGRAPHY

The topography of Judith Basin County is characterized by mountains and plains. A few of the southern peaks of the Highwood Mountains are in the northwestern corner of the county. The Little Belt Mountain Range is a broad, elevated, plateaulike area that trends southeasterly; it occupies approximately the southwestern third of the county. The eastern and northern parts of the county are comprised mainly of gently sloping gravel benches and level plains. Altitudes range from 3,000 to 4,000 feet for the plains and bench areas to an average of about 7,000 feet in the mountains. The highest point is the summit of Big Baldy Mountain, in the western part of the county, at an altitude of 9,200 feet.

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TABLE 1. - Average monthly and annual precipitation[1/] and snowfall, in inches, at following U. S. Weather Bureau Stations in and adjacent to Judith Basin County, Mont.

Station	Utica (Judith Basin County)		White Sulphur Springs (Meagher County)		Kings Hill (Cascade County)	
Elevation, feet.	5,000		5,187		7,450	
	Precipitation[1/]	Snowfall	Precipitation[1/]	Snowfall	Precipitation[1/]	Snowfall
Length of record, years ..	33	32	11	19	8	8
January	0.61	8.1	0.58	7.4	1.98	31.4
February	.41	6.0	.60	5.9	2.27	42.5
March	.81	9.0	1.00	8.2	1.93	31.8
April	1.26	5.4	1.12	6.4	2.09	24.8
May	2.81	2.9	1.75	2.8	3.11	9.0
June	3.47	.4	2.76	.6	4.56	8.6
July	2.09	.0	1.44	.1	1.94	0.0-0.2
August	1.21	.0	1.16	.0	1.97	0.0-0.2
September	1.38	1.5	1.27	2.4	2.11	9.4
October	1.10	7.3	1.06	6.2	1.98	18.2
November	.76	8.6	.68	5.8	2.21	35.6
December	.57	7.7	.88	9.1	2.40	39.1
Annual average.	16.48	56.9	14.30	54.9	28.55	250.8

1/ Includes snowfall converted to water.

TABLE 2. - Average temperature data, °F., at following U. S. Weather Bureau Stations in and adjacent to Judith Basin County, Mont.

Station	Utica	White Sulphur Springs (Meagher County)	Kings Hill (Cascade County)
Elevation, feet	5,000	5,187	7,450
Length of record, years	33	20	7
Annual average	42.8	41.0	35.4
Mean maximum:			
January	33.7	29.3	26.0
July	79.5	80.8	71.8
Annual	55.2	54.0	46.9
Mean minimum:			
January	11.0	10.0	9.4
July	49.6	47.6	43.2
Annual	30.3	28.0	24.4
Highest:			
January	62.0	64.0	-
July	104.0	99.0	-
Annual	108.0	99.0	90.0
Lowest:			
January	-46.0	-42.0	-
July	32.0	30.0	-
Annual	-57.0	-42.0	-42.0
Latest date 32° or lower in spring	May 8 to June 21	May 11 to July 8[1/]	June 8 to June 23[1/]
Earliest date 32° or lower in fall	July 20 to Oct. 11	Aug. 5 to Sept. 29[1/]	Aug. 17 to Oct. 6[1/]

1/ Below freezing temperature recorded in all months during some years.

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The mountains are deeply dissected by the headwater branches of Belt Creek, Arrow Creek, and Judith River (including Dry Wolf and Running Wolf Creeks), all of which are tributaries of the Missouri River. Stream flow is variable. Some creeks flow throughout the year, whereas others are intermittent. In the dry summer months, many of the creeks flow for short distances only; their water disappears upon reaching the plains. Water for mining and milling purposes generally is adequate in the mountain streams near most of the mining properties.

Mountain slopes above 5,000 feet, except for scattered open parks, are forested with lodgepole pine. Fir and spruce grow on the north slopes of most of the mountains. Local forests can provide an adequate source of timber for mine use.

HISTORY

Judith Basin County derives its name from the Judith River, named by William Clark when he traveled up the Missouri River with the Lewis and Clark expedition in 1804 (10). The region now comprising Judith Basin County formerly was a part of Meagher County. Some of the eastern part of Meagher County was included in Fergus County when it was organized in 1885. The western part of Fergus County became a part of Cascade County when that county was formed in 1887. In December 1920, Judith Basin County was created from parts of Cascade and Fergus Counties.

Many of the gulches on the east side of the Little Belt Mountains were prospected for gold during the 1860's. Gold was discovered in Yogo Gulch about 1865, but the prospectors were driven away by hostile Indians. Placer mining was resumed in Yogo Gulch in 1879, but these operations, for the most part, were abandoned when the silver-lead deposits at Barker and Hughesville were discovered. The town of Yogo, which at one time had a population of about 1,200, was virtually deserted by 1883. Some placer mines were operated intermittently on a small scale at Yogo, Elk, Lion, Skunk, Black Tail, and other gulches until as late as 1897.

The silver-lead deposits near Barker - first known as Clendennin - were discovered October 23, 1879, by Buck Barker and Pat Hughes (8). Other discoveries soon were made. A rush to the new camp followed; hundreds of claims were located. Feverish mining activity resulted; several of the mines soon became important producers. Large quantities of high-grade ore were mined and hauled to Fort Benton and shipped from there by river steamers to distant smelters. To avoid excessive transportation costs, smelters were constructed at Clendennin and at Hughesville. The smelter at Hughesville was operated only a short time, because the furnace did not have a suitable refractory lining. The 40-ton smelter at Clendennin was equipped with a water-jacketed furnace. This smelter was operated about 18 months by Col. George Glendennin; it produced $375,000 worth of bullion. Operations ceased when Col. Clendennin was killed by falling rock at the Wright and Edwards mine in 1883 (8).

Mining operations in the Barker district waned with the depletion of the rich, near-surface, argentiferous, lead-carbonate ore bodies.

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Deeper exploration in most of the mines developed lower-grade, more base ore that could not be mined and shipped at a profit (21). The railroad was constructed to Barker from Monarch in 1891. Several of the larger mines then resumed operations. The demonitization of silver in 1892, however, forced most of them to close. Small-scale operations by claim owners and lessees, nevertheless, continued intermittently at many of the properties, although no large operations were undertaken again until 1927, when the Block P group of claims was acquired by the St. Joseph Lead Co. This company constructed a modern, 400-ton, selective-flotation plant and operated the Block P mine continuously until September 30, 1930. The mine remained idle until 1941, when the company again resumed operations, which continued until 1943 (21) (22). In recent years, only a few small-scale operations have been conducted by claim owners or lessees.

Sporadic mining has been carried on at numerous lead, silver, and gold properties throughout the mountains along the western part of the county. Some of these properties produced small quantities of ore. Most of the deposits were small and isolated; their operation generally was unprofitable. Most of these mines have been idle for many years.

The discovery of sapphire in a basic dike near Yogo Gulch in 1896 created much interest in that area. Considerable mining activity resulted. Several companies mined sapphire along this dike for many years. Control of the entire sapphire-bearing dike was acquired by the New Mines Sapphire Syndicate, a British company, in 1914 (19). Operations by this company continued until 1929, when all sapphire mining in the county ceased.

PRODUCTION

Table 3 shows the recorded mine production of gold, silver, copper, lead, and zinc in Judith Basin County from 1921 to 1948, inclusive, in terms of recovered metals valued at $5,946,294. Judith Basin County was created from a part of Cascade County and western Fergus County in December 1920. Production from most of the mines in this area from 1889 to 1920, inclusive, is included in the production of Cascade County. No segregated county records of production prior to 1889 are available. It is known, however, that some of the mines in the Barker, Yogo, and Running Wolf districts were productive for some years prior to 1889; gold placers were mined in several areas as early as 1879. It is apparent, therefore, that the total metal production from the area now included in Judith Basin County was considerably larger than that shown in table 3.

Lead, silver, and zinc have been the principal metals produced; they have been mined mainly in the Barker district. Lode gold mining has been of secondary importance. Although placer gold was discovered about 1865 in Yogo Gulch, production has not been large; recorded production since 1920 has amounted to only 21.12 ounces. No other metals are reported to have been produced in the county except those recorded in table 3.

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TABLE 3 . - Mine production of gold, silver, copper, lead, and zinc in Judith Basin County [1], Mont., 1921-1948, in terms of recovered metals

Year	Producing mines		Ore sold or treated	Gold				Silver			Copper		Lead		Zinc		Total value
				Fine ounces				Fine ounces									
	Lode	Placer	short tons	Lode	Placer	Total	Value	Lode	Placer	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1921[2]	9	-	4,935	126.21	-	126.21	$2,609	98,050	-	$98,050	945	$122	1,715,151	$77,182	-	-	$177,963
1922	8	-	15,107	160.31	-	160.31	3,314	94,394	-	94,394	-	-	1,949,428	107,218	-	-	204,926
1923	5	-	16,973	223.92	-	223.92	4,629	88,147	-	72,281	4,430	851	1,691,611	118,413	-	-	195,974
1924	6	-	26,354	296.49	-	296.49	6,129	115,506	-	77,388	4,304	564	2,544,123	203,530	-	-	287,611
1925	5	-	29,292	439.24	-	439.24	9,080	148,715	-	103,208	5,918	840	2,839,317	247,021	3,315	$252	360,401
1926	5	1	28,875	345.49	1.50	346.99	7,173	143,561	-	89,582	1,234	173	2,774,498	221,969	-	-	318,887
1927	5	1	3,589	135.16	1.60	136.76	2,827	34,443	-	19,529	732	96	827,246	52,116	7,227	462	75,030
1928	5	1	5,435	29.37	1.35	30.72	635	31,809	-	18,608	8,329	1,199	540,000	31,320	347,278	21,184	72,946
1929	5	1	106,751	698.55	1.02	699.55	14,461	784,185	-	417,971	293,201	51,621	12,274,961	773,323	7,770,524	512,855	1,770,231
1930	3	-	82,552	562.12	-	562.12	11,620	603,317	-	232,277	247,274	32,146	9,155,321	457,766	6,454,404	309,811	1,043,620
1931	2	1	74	1.11	.68	1.79	37	835	-	242	2,612	238	44,568	1,649	-	-	2,166
1932	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1933	4	-	100	3.00	-	3.00	62	2,280	-	798	344	22	56,162	2,078	8,405	353	3,313
1934	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1935	3	2	59	1.40	7.97	9.37	328	1,134	-	815	241	20	44,875	1,795	-	-	2,958
1936	2	2	15	.60	7.00	7.60	266	377	-	292	-	-	9,000	414	-	-	972
1937	4	-	482	35.00	-	35.00	1,225	5,872	-	4,542	5,000	605	302,000	17,818	37,000	2,405	26,595
1938	1	-	780	38.00	-	38.00	1,330	12,524	-	7,967	2,925	290	565,087	25,994	-	-	35,581
1939	3	-	2,733	109.00	-	109.00	3,815	38,529	-	26,153	11,251	1,168	1,566,745	73,637	22,000	1,144	105,917
1940	1	-	419	13.00	-	13.00	455	4,434	-	3,153	1,000	113	251,100	13,055	-	-	16,776
1941	5	-	300	116.00	-	116.00	4,060	2,714	-	1,930	14,900	1,758	43,400	2,474	-	-	10,222
1942	3	-	36,724	221.00	-	221.00	7,735	216,135	-	153,696	115,000	13,915	3,407,000	228,269	1,751,000	162,843	566,458
1943	4	-	51,468	270.00	-	270.00	9,450	211,680	-	150,528	115,700	16,041	3,217,200	241,290	1,442,000	155,736	572,045
1944	3	-	100	24.00	-	24.00	840	1,845	-	1,312	2,000	270	27,600	2,208	-	-	4,630
1945	3	-	707	52.00	-	52.00	1,820	3,240	-	2,304	17,600	2,376	40,500	3,483	16,200	1,863	11,846
1946	2	-	240	53.00	-	53.00	1,855	2,385	-	1,927	500	81	46,000	5,014	20,500	2,501	11,378
1947	3	-	377	13.00	-	13.00	455	6,484	-	5,868	2,300	483	177,000	25,486	55,600	6,728	39,022
1948	3	-	218	6.00	-	6.00	210	4,592	-	4,156	1,000	217	99,700	17,846	48,100	6,397	28,826
Totals			414,285	3,972.96	21.12	3,994.07	$96,420	2,654,987	-	$1,588,971	866,818	$124,009	45,219,587	$2,952,360	17,913,553	$1,184,534	$5,946,294

1/ Judith Basin County organized December 1920.
2/ Production prior to 1921 not segregated but combined for years 1889-1920 with that of Cascade County.

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The most important nonmetallic mineral produced has been the gem-quality sapphire. Sapphire production to 1929 is estimated at about 16,000,000 carats, of which about 15 percent was of gem quality, the balance being mainly industrial grade. The value of the uncut gem-quality stones produced was about $2,500,000. On the average basis of $30 to $40 per carat, retail price, the value of the cut gems has been estimated at $20,000,000 to $30,000,000 (2).

GEOLOGY

Few reports on the geology in Judith Basin County have been published. Weed studied and mapped the Little Belt and Highwood Mountain Ranges and vicinity shortly before 1900. The following geologic information has been briefed mainly from his reports (26) (27) (28).

The general structure of the Little Belt Mountain Range is a broad, dome-shaped uplift, the northern and eastern parts of which are in Judith Basin County. Sedimentary rocks near the summit of the dome are nearly horizontal; those on the northern and eastern flanks dip steeply toward the plains. Numerous local domes of laccolithic origin have obscured the simple folds of the uplift by further deforming the sedimentary beds, particularly about the margin of the range and immediately beyond it. These local laccolithic domes are so large and abundant as to form the most prominent structural features of the mountains. Erosion has removed the tops of many of the domes, exposing their igneous cores surrounded by sedimentary rocks with steep but variable dips.

The oldest rocks of the region are Archean gneisses and schists, which occur near the center of the Little Belt Mountain Range. Sedimentary rocks range in age from Cambrian to Cretaceous (figs. 2 and 3). The most common intrusive rock is granite porphyry. Local variations include syenite prophyry, diorite porphyry, monzonite, and a number of intervening varieties, to which Weed gave the name Barker prophyry, Wolf porphyry, and shonkinite (27). Metamorphism of sedimentary rocks near the igneous intrusions was moderate; the zone of altered rocks rarely extends more than a few yards from the contact.

All the known economic metallic mineral-bearing deposits of Judith Basin County are in the Little Belt Mountain Range. The principal deposits are in fissure veins in syenite. Irregular replacement deposits in sedimentary rocks, chiefly limestone near igneous contacts, also have been important producers.

The Highwood Mountains are mostly in Chouteau and Cascade Counties, but a few of the peaks are in the northwestern corner of Judith Basin County. The rocks of these mountains are mainly dark basaltic extrusives resulting from lava flows or from ejected volcanic material. Some stocks of granular intrusive rocks fill former volcanic conduits. A great number of basaltic dikes radiate from the mountains and cut the surrounding sedimentary rocks. No metallic mineral deposits of economic importance have been reported in the Highwood Mountains (27).

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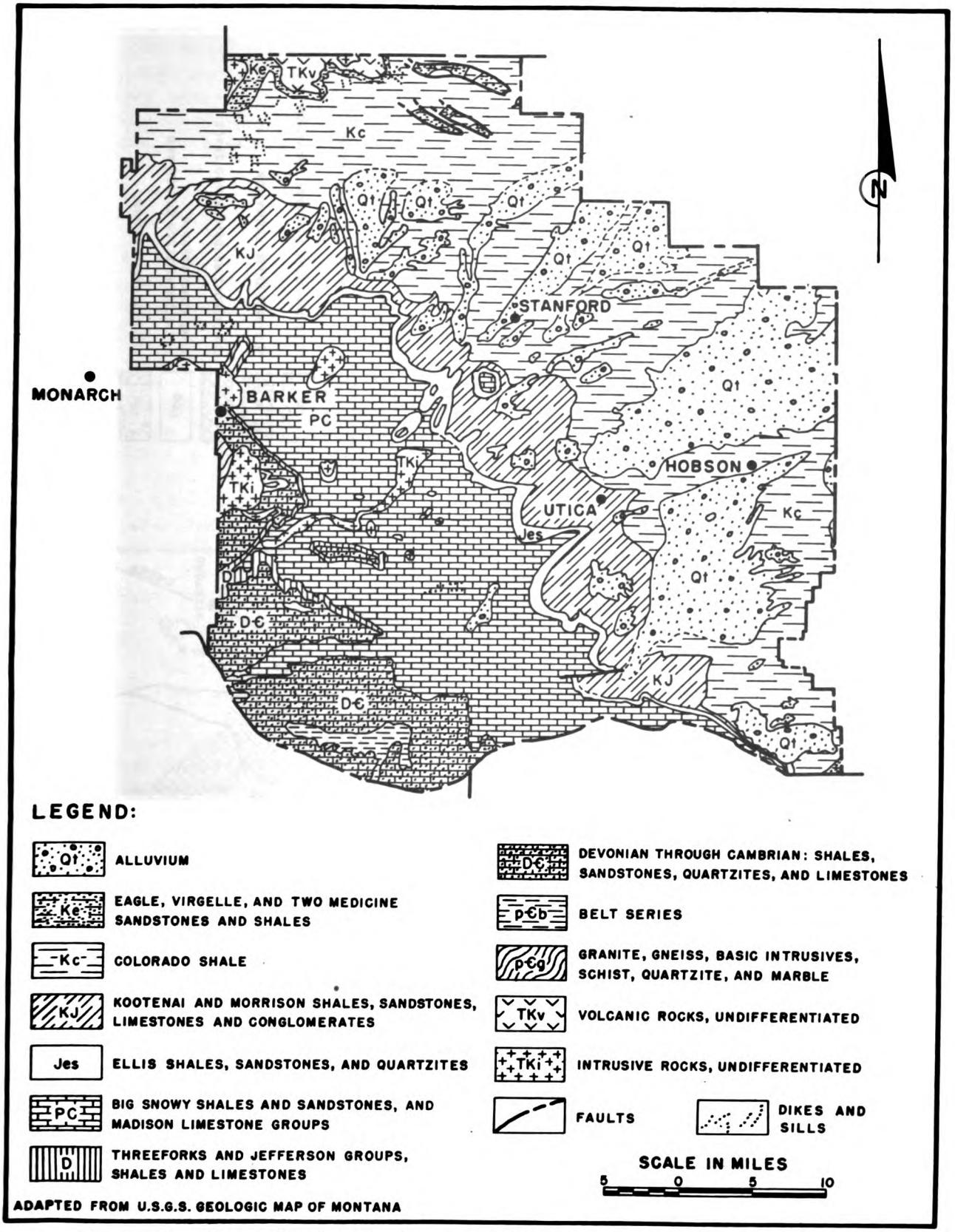

Figure 2.—Generalized geologic map of Judith Basin County, Mont.

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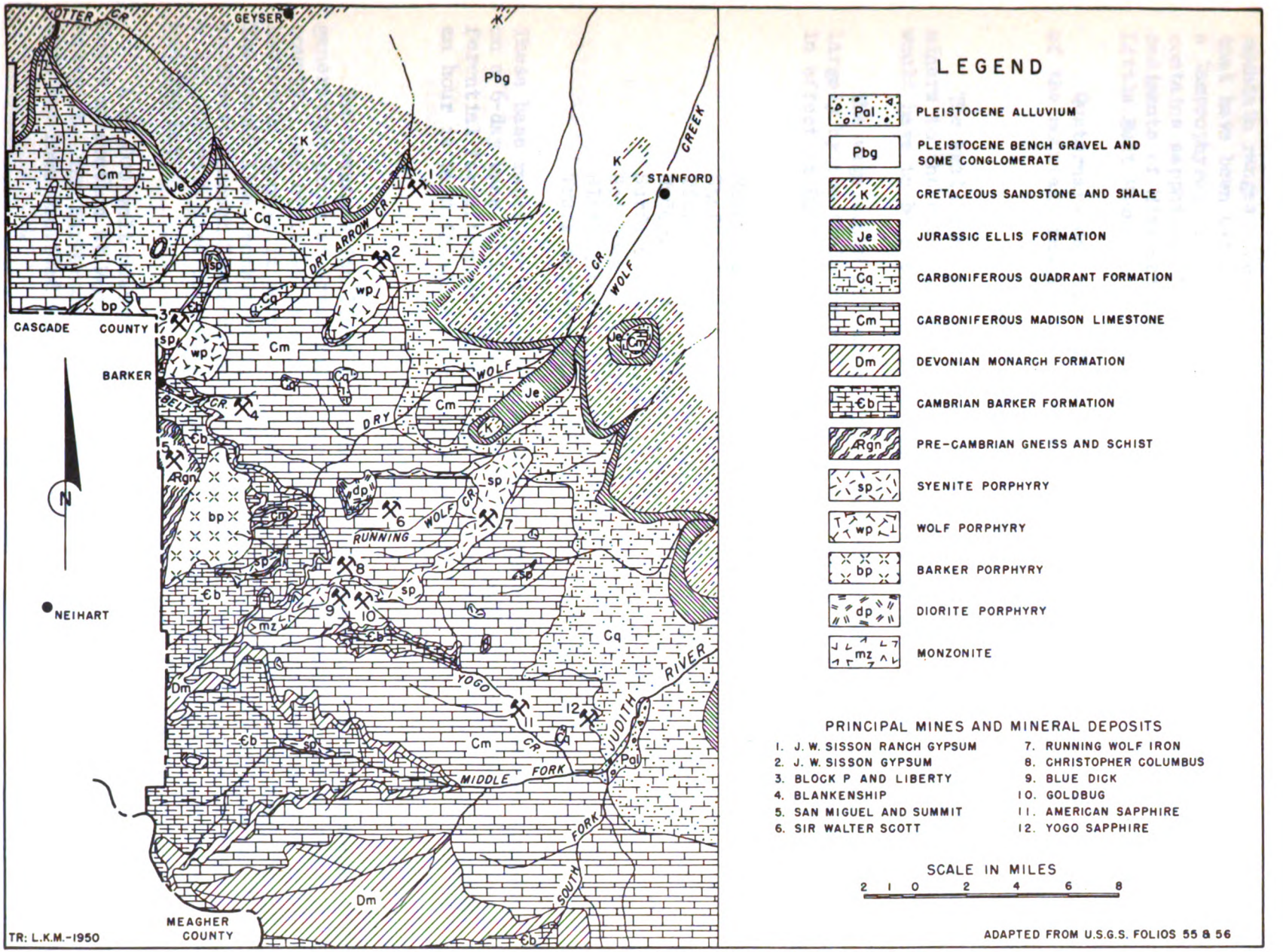

Figure 3.— Geologic map of southwestern Judith Basin County, Mont.

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A few non-metallic-mineral deposits occur in the foothills of both mountain ranges. Sapphire and gypsum are the only nonmetallic minerals that have been exploited (fig. 3). East of the Little Belt Mountains, a lamprophyre, or minette dike, cutting flat-lying Madison limestone, contains sapphire. Extensive gypsum deposits are interbedded with shaly sediments of Mississippian age in the low hills north and east of the Little Belt Mountains (14).

Quaternary deposits of gravel and glacial drifts on the plains east of the mountain ranges are underlain by Cretaceous sediments.

LABOR SUPPLY AND WAGE SCALE

The small mine operations of recent years have drawn few experienced miners to the county. Miners and mine laborers for future operations would have to be recruited from other mining areas.

The wage scale at most mining districts in Montana is influenced largely by the scale prevailing at Butte, Mont. Some of the basic wages in effect at Butte during the fall of 1949 were as follows:

	Base for 8-hour shift
Miners	$11.11
Shaft miners	11.61
Timbermen	11.11
Underground shovelers	11.11
Surface labor	10.61
Hoistmen	12.36
Blacksmiths	11.70
Truck drivers	11.20 to 11.70

These base rates are for a 40-hour week. The mines at Butte are operated on a 6-day week basis. Time and one-half is paid for overtime. A differential for afternoon, night, and graveyard shifts of 4, 6, and 8 cents an hour is paid in addition to the base rate.

POWER

Two transmission lines from the Montana Power Co.'s hydroelectric generating plant at Great Falls, Mont., cross the central part of the county. One of these is a 50,000-volt line that extends eastward to Lewistown, Mont.; it serves the towns in central Judith Basin County. The second line, completed in 1948, carries 110,000 volts; it extends southeast through Stanford to Harlowton, Mont., where it connects with a 110,000-volt line extending from Great Falls through Monarch, Neihart, and Two Dot.

A 23,000-volt distribution line extending from the Montana Power Co.'s substation at Monarch provides power to the mines in the Barker district. The Barker district is the only mining district in the county that has been provided with electric power.

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Electric energy is provided by the Montana Power Co. to consumers in Montana at rates shown in the following schedule. The rates are based on a sliding scale for kilowatt-hours actually consumed, plus a charge based on peak kilowatt demand.

Montana Power Co. schedule GS-44 power rates

Charge for kilowatt-hours consumed:

$0.75 for the first 12 kw.-hr. or less.
0.035 per kw.-hr. for the next 288 kw.-hr.
0.025 per kw.-hr. for the next 1,500 kw.-hr.
0.015 per kw.-hr. for the next 3,200 kw.-hr.
0.009 per kw.-hr. for the next 15,000 kw.-hr.
0.007 per kw.-hr. for the next 200 kw.-hr. per kw. of demand.
0.005 per kw.-hr. for all additional kw.-hr.

Plus charge for kilowatts of demand:

First 10 kw. ..... No charge
Next 20 kw. ..... $0.95 per kw.
All additional kw. ..... .75 per kw.

TRUCKING RATES

Trucking charges on ore and concentrate from mine or mill to shipping point or smelter are based on length of haul, difference in elevation between points of origin and destination, condition of roads, and the size and regularity of the shipments. Varying conditions make it impossible for trucking firms to quote open price schedules; consequently, negotiations between shipper and trucker are necessary.

Trucking rates often are based on an average of about 10 cents per ton-mile for hauling over paved or good-quality roads with little grade. The rate may range up to 50 cents or more per ton-mile over steep, poor-quality roads, or may be as low as 3 cents per ton-mile for long hauls over paved highways.

RAILROAD FREIGHT RATES

Railroad freight rates on ore and concentrate per ton in 30-ton minimum carload lots from railroad points in and adjacent to Judith Basin County to smelter in Montana, as of October 1949, were as follows:

Great Northern Railroad

Value, per ton, not exceeding-	$15	$25	$35	$50	$100	Over $100
To A.S. & R. Co. smelter, East Helena, Mont., from:						
Hobson	$3.34	3.72	4.16	4.61	4.91	5.50
Stanford	3.07	3.42	4.01	4.36	4.76	5.35
Raynesford	2.81	3.12	3.58	4.01	4.36	4.76
Armington, Cascade County	2.41	2.94	3.47	3.86	4.13	4.66

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Value, per ton, not exceeding-	$15	$25	$35	$50	$100	Over $100
To Washoe sampler, A.C.M. Co., Butte, Mont., from:						
Hobson	$3.73	4.16	4.61	5.20	5.35	5.95
Stanford	3.47	3.86	4.46	4.91	5.20	5.80
Raynesford	3.34	3.72	4.31	4.76	5.05	5.65
Armington	3.34	3.72	4.31	4.76	5.05	5.65
To A.C.M. Co. zinc plant, Great Falls, Mont., from:						
Hobson	2.15	2.39	2.68	3.12	3.42	3.72
Stanford	2.02	2.23	2.53	2.98	3.12	3.58
Raynesford	1.52	1.79	2.23	2.68	2.82	3.12
Armington	1.49	1.63	1.93	2.23	2.39	2.53

Freight rates between the above shipping points and smelters outside of Montana are not available, but rates may be established upon application to the traffic agent of the railroad.

SMELTER SCHEDULES

It is difficult and generally impossible for smelting companies to quote open schedules on most ores and concentrates. Applicable schedules usually are established only after the analysis of representative samples of the ore or concentrate and the tonnage to be treated are known.

The following schedules for ores and concentrates at smelters in Montana have been summarized from those in effect October 1949.

East Helena smelter, American Smelting & Refining Co., copper-lead-gold-silver ores and concentrates

Payments for metals:

Gold - minimum paid for, 0.03 ounce per ton.

Ounces per ton	Per ounce
0.03 to 3.0	$31.81825
Plus 3.0	32.31825

Silver - pay for 95 percent at average of the Handy & Harman, New York, quotations, or Mint price, less minimum deduction 1 Troy ounce per dry ton.

Lead - If 3 percent or over by wet assay, deduct from wet aaasy 1.5 units (a unit is 20 pounds) and pay for 90 percent of the remaining lead at the average of the daily published A. S. & R. Co. quotations for common desilverized domestic lead for delivery in New York City, less 1.8 cents per pound of lead accounted for.

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Copper - If 1 percent or over, deduct from wet copper assay 1 unit and pay for 100 percent of the remaining copper at daily net refinery quotations for electrolytic cathodes as published in E. & M. J. Metal & Mineral Markets of New York, less a deduction of 6 cents per pound of copper accounted for.

Deductions:

Base charge - $8 per net dry ton for treatment of ores and concentrates having a settlement lead content of 20 percent or less; deduct 10 cents per ton for each unit of lead over 20 percent, fractions in proportion; $7 per ton for those having no payable lead content.

Arsenic and antimony (combined) - 2 percent free; excess charged at 50 cents per unit, fractions in proportion. 0.1 percent of lead content by wet assay allowed free; excess charged at 50 cents per pound.

Zinc - 10 percent free; excess charged at 30 cents per unit, fractions in proportion.

Sampling and assaying - Charge $10 per lot when less than $200 value and $20 per lot when over $200 value for shipments of less than 5 tons dry weight. Charge $5 per lot when less than $200 value and $10 per lot when over $200 value for shipments less than 10 tons dry weight.

Washoe sampler, Anaconda Copper Mining Co., Butte, Mont., copper, gold, and silver ores and concentrates

Payments for metals:

Copper - 96 percent of copper content, with minimum deduction of 10 pounds per ton, at E. & M. J. average price of electrolytic copper for week ending Wednesday preceding date of sampling, less 2.5 cents per pound.

Silver - 95 percent of silver content, with minimum deduction of 1 ounce per ton at Government price less 2 cents per ounce. Silver not eligible for Government price will be paid for at open market quotation, as quoted by E. & M. J.

Gold - 95 percent of gold content, with minimum deduction of 0.01 ounce per ton, at $20 per ounce, plus 90 percent of premium in excess of $20.67 per ounce. (This is equivalent to paying for 100 percent at $31.81825 per ounce.)

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Treatment charge, f.o.b. Washoe sampler, Butte, Mont.:

Base charge - $4 per ton.
Add 10 percent of sum of metal payments in excess of $15 per dry ton.
Add 12 cents for each 1 percent iron (Fe).
Deduct 2.5 cents for each 1 percent of silica (SiO_2) in excess of alumina (Al_2O_3).
Maximum total treatment charge to be $5.50 per dry ton.

In case company elects to have shipments made direct to the smelter at Anaconda for sampling, the base treatment charge will be $3.75 per dry ton, f.o.b. Anaconda Reduction Works, Anaconda, Mont., with maximum total treatment charge of $5.25 per dry ton. Lots of less than 10 tons will be assessed an extra sampling charge of $5 flat on each lot.

Electrolytic zinc plants, Anaconda Copper Mining Co. at Anaconda and Great Falls, Mont. zinc concentrates

Schedules for the treatment of zinc ores or concentrates at the Great Falls and Anaconda zinc plants are not quoted by the Anaconda Copper Mining Co. Because certain impurities complicate the treatment at these plants, only certain types and grades of zinc concentrates are acceptable. The acceptability is determined only after complete analysis of a representative sample of the zinc concentrate involved. If satisfactory, the prospective shipper then will be offered terms of purchase.

Terms of purchase of acceptable zinc concentrate by these zinc plants are indicated by the following, which pertain to shipments made by one producer in Cascade County during the spring of 1949:

Payments for metals in zinc concentrates:

Zinc - Eighty percent (80%) of zinc content at St. Louis price for prime western zinc.

Lead - Eighty percent (80%) of lead content in excess of 3 percent, at New York price, less 2 cents per pound.

Silver - Eighty percent (80%) if 1.0 ounce per ton or over.

Gold - One hundred percent (100%) if 0.01 ounce per ton or over, at $27.024 per ounce.

Other metals - No payment shall be made for any other metal or metals contained in concentrates, and such metals shall be the property of the Anaconda Co.

Prices for zinc and lead shall be those quoted by Engineering & Mining Journal for week of arrival of concentrates at plants of Anaconda Co.

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Treatment charge:

Base treatment charge shall be thirty dollars ($30) per dry ton of concentrates delivered and accepted, based on St. Louis price of prime western zinc of 10-1/2 cents (10-1/2¢) per pound; a cost of labor in the zinc plants of the Anaconda Copper Mining Co. at Anaconda and Great Falls, Mont., based at $11.40 per 8-hour day, with the addition to or subtraction from said base treatment charge per dry ton of concentrates of 1 cent (1¢) for each 1 cent (1¢) increase or decrease in said cost of 8-hour day employment; a lead content of 3 percent (3%); and arsenic plus antimony content of 0.125 percent.

There shall be added to or subtracted from said base treatment charge, 1 dollar ($1) per dry ton of concentrates for each 1 cent (1¢) per pound increase or decrease in the price of prime western zinc at St. Louis above or below 10-1/2 cents (10-1/2¢) per pound, fractions proportionately. Fifty cents (50¢) per dry ton of concentrates shall be added to said treatment charge for each percent (1%) lead below 3 percent (3%) in such concentrates, fractions in proportion. Twenty-five cents (25¢) per dry ton of concentrates shall be added for each 1 percent (1%) of insoluble material plus iron. Twenty cents (20¢) per dry ton of concentrates shall be added for each 0.10 percent arsenic plus antimony in excess of 0.125 percent.

METALLIC MINES AND MINERAL DEPOSITS

The metallic mines and mineral deposits of Judith Basin County are grouped in four districts, as shown in figure 1. The location of the deposits investigated is shown on the Mineral Industry Survey map at the end of the report. The symbols on the map indicate the predominant metal or metals; the numbers refer to the mines or deposits on which summarized data are given in the table accompanying the map.

Most of the metallic mines and prospects in Judith Basin County have been inactive for many years. Many of them have produced a small amount of ore. Most of the county's metal production, however, has been made by a few mines in the Barker district. The Block P mine group in the Barker district alone has been credited with about 95 percent of the county's metal production since the county's organization in 1920. Only three claims, the Wright claim of the Block P group and the Tiger claim, both in the Barker district, and the Sir Walter Scott claim in the Running Wolf district produced ore during 1948. Their combined production during 1948 amounted to only 218 tons (see table 3).

Barker District

The Barker district includes the mountainous areas drained by the Dry Fork of Belt Creek and its tributaries west of the divide between the Dry Fork of Belt Creek and Dry Wolf Creek and the areas drained by the headwater branches of Otter and Arrow Creeks (fig. 1).

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Most of the mines and prospects in the district are in the near vicinity of the old towns of Barker and Hughesville. These old mining camps are in the narrow valley of Galena Creek, which flows southward into the Dry Fork of Belt Creek about 13 miles east from Monarch.

An improved graveled road extends from Monarch to Barker. An unimproved road extends from Barker up Galena Creek to Hughesville and over the Kibbey Divide to the towns of Geyser and Raynesford, both on a branch line of the Great Northern Railroad. Another unimproved road extends up the Dry Fork of Belt Creek. This road, known locally as the "Blankenship Trail," crosses the divide and connects with the county road leading down Dry Wolf Creek to Stanford, the county seat of Judith Basin County.

Altitudes range from 6,000 to over 8,000 feet within a few miles of Barker. Rugged mountains rise steeply on both sides of Galena Creek Canyon. Both Barker Mountain on the west and Mixes Baldy on the east are of laccolithic origin. Their cores are composed mainly of granite porphyry. Between these mountains and around their edges are the uplifted remnants of older sedimentary rocks, which dip away in all directions from the intrusive masses. Near the upper end of Galena Creek Canyon, a stock of syenite intruded igneous and sedimentary rocks (27) (fig. 3).

The more important ore bodies of the district occur in veins either in syenite or along its contact with the surrounding rocks. Other ore deposits occur at or near the contact of granite porphyry with Carboniferous, Devonian, or Cambrian sedimentary formations (26).

The Barker district has made a much greater production than the combined production from all of the other districts in the county. During the early mining days, few records of the production of the various mines and prospects were kept. Some mines are known to have made a considerable production between 1879, when the first deposits were discovered, and 1913. Production from the Barker district from 1913 to 1948, inclusive, is reported to have been 409,002 tons of ore, from which were recovered 3,435.13 ounces gold, 2,653,375 ounces silver, 788,900 pounds copper, 44,366,327 pounds lead, and 17,939,544 pounds zinc (13). Most of this production was obtained from one group of claims (Block P), which were intensively operated from 1927 to 1930 and from 1941 to 1943. This ore deposit has been developed to a depth of 1,400 feet. Mining on other nearby properties has been confined to comparatively shallow workings.

No metals other than those recorded above have been credited to the ores produced from the Barker district. Most of the ores, however, contain small amounts of cadmium, arsenic, antimony, molybdenum, and manganese.

The mines and prospects in the Barker district were all in Cascade County until 1920, when Judith Basin County was organized. The changes in the county boundaries resulting from this organization placed most of the Barker district in Judith Basin County but left a few mines and prospects along the western edge in Cascade County. These mines are described in a separate report on Cascade County.

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Block P (Wright-Edwards, Barker) (Ag-Pb-Zn)

The present Block P mining property includes 13 patented claims and several unpatented claims, all near the old town of Hughesville. The principal patented claims are the Barker, Wright, Edwards, and Grey Eagle; they were among the first claims located in the Barker district. The Barker claim was located October 23, 1879, by Buck Barker and Patrick W. Hughes. The Wright and Edwards claims were located in 1880; they were owned soon after by John W. Power, et al. These claims, and the Grey Eagle claim owned by Patrick W. Hughes, were surveyed for patent during 1881.

The claims at first were developed and mined independently by the various owners or lessees. Some of the first ore was hauled to Fort Benton, from whence it was shipped down the Missouri River to distant smelters. Much of the ore, however, was smelted locally until 1883 (8). Mining then declined until 1891, when the railroad branch was completed to Barker. The spur line from Monarch to Barker was removed about 1902.

In 1892 the Barker mine was owned and operated by Paris Gibson, T. C. Power, and C. X. Larrabie (12). After some years of inactivity, most of the claims were leased to the United Smelting & Refining Co. in 1898 (27). The company operated the mines until about 1902, shipping the ore to its smelter at Great Falls. Ownership of most of the claims by that time had been acquired by T. C. Power, who then organized the Block P Mining Co., named after the flag design of Power's Missouri River steamboats. This company and lessees then operated the mine intermittently on a small scale. A 75-ton gravity mill was built during 1910 and 1911 (24). Mill capacity was increased to 100 tons in 1920. Operations continued more or less steadily until 1927, when the Block P Mining Co. holdings were purchased by the St. Joseph Lead Co.

The St. Joseph Lead Co. constructed a new 400-ton selective flotation plant at a site just south of Barker. The railroad spur from Monarch to Barker was rebuilt. The mine was equipped with a new steel headframe and ore bins. Extensive development was done. A 10,250-foot aerial tramway was constructed between the mine headframe and the new flotation plant. Mining and milling continued steadily until September 1930, when all operations were suspended because of unfavorable market conditions (21). Operations were resumed in 1941 and continued until October 1943, when all company operations ceased (20-1943). The mine and most of its equipment were sold to Thorson Brothers and Brazee (20-1944). The mill was dismantled, the railroad tracks were removed, and the railroad right-of-way was abandoned.

Thorson Brothers and Brazee sold their holdings about a year later to the American Smelting & Refining Co. but reserved the right to mine ore from the adits above the collar of the shafts. Thorson Brothers and Brazee have mined a small amount of ore each year since 1944 from the old upper adit levels, but the Block P mine otherwise remains idle.

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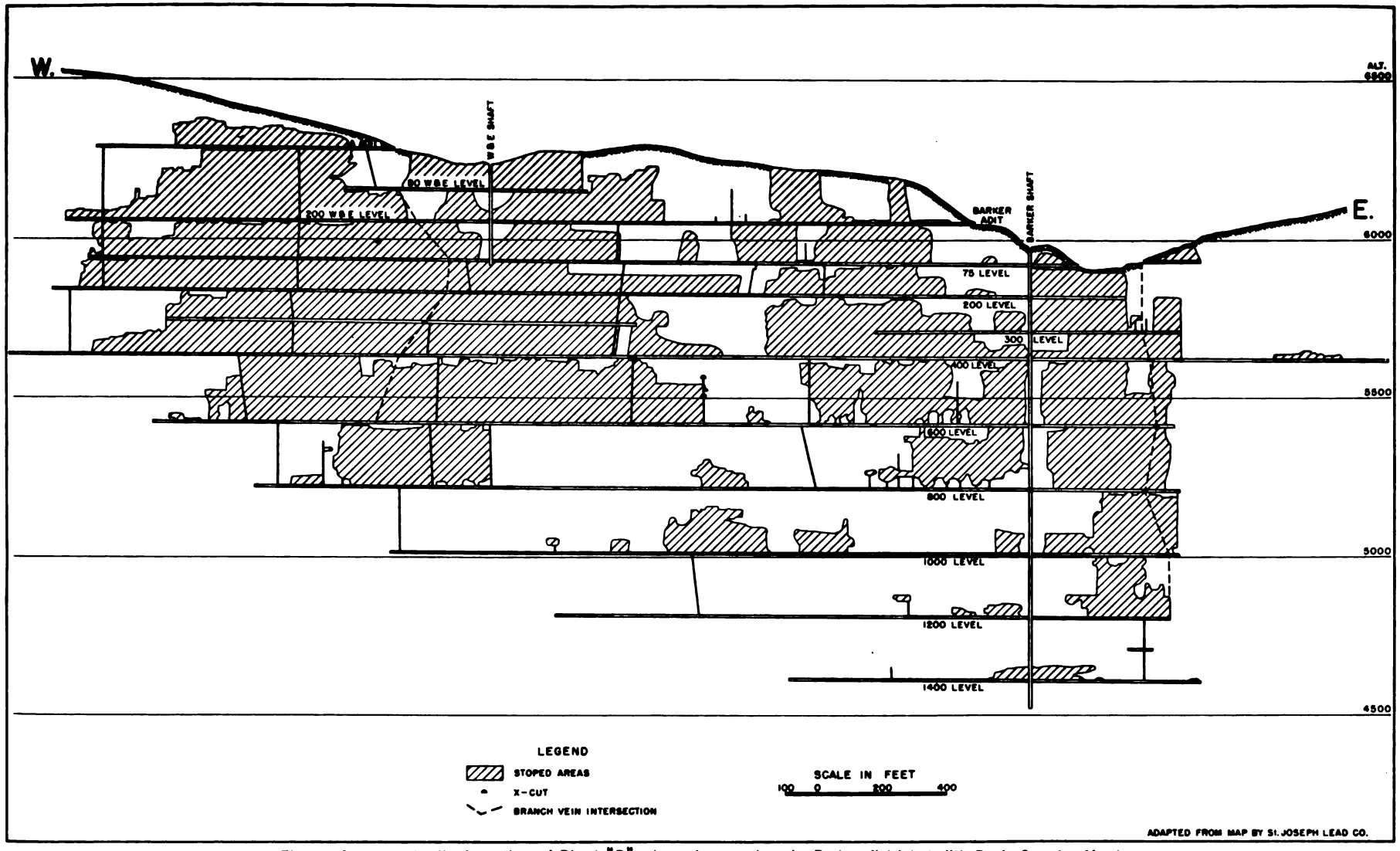

Figure 4. — Longitudinal section of Block "P" mine along main vein, Barker district, Judith Basin County, Mont.

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Mine workings during the early days consisted mainly of shallow pits and adit drifts. After the depletion of the rich, near-surface carbonate ores, two small vertical shafts were sunk, and crosscuts were driven to the vein. The original single-compartment Barker shaft was 800 feet deep with levels at approximately 100-foot intervals above the 400-foot level; the levels below the 400-foot level were about 200 feet apart (20-1927)(fig. 4). This shaft later was enlarged to a two-compartment shaft and sunk to a depth of 1,484 feet by the St. Joseph Lead Co. It became the main working shaft. The Wright-Edwards two-compartment shaft was 320 feet deep in 1892, when an explosion wrecked the shaft building and hoist (12); they were never replaced. The 75-foot level from the Barker shaft connects with the lowest Wright-Edwards shaft level. An adit drift about 2,800 feet long extends westward from near the Barker shaft collar; it connects with the second level of the Wright-Edwards shaft. Another adit drift, driven westward from a point about 270 feet to the northwest and about 50 feet higher in altitude than the collar of the Wright-Edwards shaft is about 900 feet long. Several hundred feet of adits also were driven on the Grey Eagle and other claims in the group. Altogether, more than 20,000 feet of drifts and crosscuts had been driven by the time the mine was closed in 1943.

Mining methods at the Block P mine are described in Bureau of Mines Information Circular 6416 (21). Milling methods are described in Information Circular 6447 (22).

The main vein in the Barker and Wright-Edwards claims occupies a well-defined, persistent fissure in a mass, or plug, of granular syenite which has intruded Barker granite porphyry. The syenite plug is cut by numerous dikes and sheets of porphyry (26). The vein extends through the three claims in a general east-west direction; it is in the form of a semicircle or crescent. The dip is northward; it ranges from 65° to 88°, the steeper dips prevail below the 1,200-foot level. In some places the vein follows the contact of syenite and porphyry. The main vein has some branches which extend into both walls. The main vein ranges to 6 feet in width; the average width is about 3 feet. According to T. J. Vaughn-Rhys, Monarch, Mont., the sulfide minerals occur in bands, lenses, and as disseminations. The sulfide lenses generally range from 6 to 24 inches in width, but in some places they have been 5 to 6 feet wide for the full width of the vein.

The sulfide minerals are mainly galena, sphalerite, marmatite, pyrite; tetrahedrite and chalcopyrite also are present. According to Spiroff (17), most of the silver is associated with the copper minerals. The gangue minerals consist of quartz, calcite, barite, rhodochrosite, and altered syenite or granite porphyry.

Several branch veins have been mined for short distances. William Thorson, Great Falls, Mont., a former superintendent of the mine, states that a branch vein encountered on the 1,200-foot and the 1,400-foot levels was not mined. A large tonnage of ore is reported to have been developed along the main vein on the 1,200-foot and 1,400-foot levels, but little of it was mined before the mine was closed in 1943.

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Production data for the various claims during the early-day operations are fragmentary. McKnight (12) has reported that 300 tons of ore assaying 65 ounces silver and 40 percent lead was mined from the Barker claim in 1883. According to Hogan (8), the Wright and Edwards mine produced 700 to 800 tons of ore monthly during 1890; this ore averaged 40 ounces silver a ton. McKnight (12) reported that the production of the Wright-Edwards mine up to 1892 was about 2,700 tons of ore, which averaged 42 ounces silver a ton and 48 percent lead.

Production from the Block P mine, 1915 to 1948, inclusive, is recorded (13) to have been 405,852 tons of ore, from which the metals recovered were as follows:

Period	Ore, tons	Ounces		Pounds		
		Au	Ag	Cu	Pb	Zn
1915-1920	1,560	66.11	49,247	6,469	904,733	-
1921-1930	316,054	2,877.02	2,090,173	550,911	34,964,584	14,579,545
1942-1945	87,963	378.00	430,569	216,315	6,689,323	3,209,200
1947-1948	275	11.00	8,235	1,417	191,777	59,653
Total..	405,852	3,332.13	2,578,224	775,112	42,750,417	17,848,398

The Block P mine has been by far the largest metal producer in Judith Basin County. It was the largest individual mine producer in Montana during 1929, when it milled 106,537 tons of ore (20-1929). The average metal content of this ore and the concentrates produced therefrom are reported to have been as follows:

	Oz./ton		Percent		
	Au	Ag	Cu	Pb	Zn
Mill heads	-	9.09	0.03	6.21	5.01
Lead concentrates	0.05	50.0	-	61.0	5.7
Zinc concentrates	.02	31.0	-	1.0	51.0

When visited in 1948 and 1949, Thorson Brothers and Brazee were mining through the Barker adit; about a carload of lead ore was in the bin below the adit portal. This adit was accessible and in good condition for several hundred feet. The A adit above the Wright-Edwards shaft was accessible and in fair condition for about 300 feet from the portal. The Wright-Edwards shaft was caved at the surface. The Barker shaft apparently was in good condition but was filled with water to the 75-foot level.

Liberty (Ag-Pb-Zn)

The Liberty group of seven patented claims is on the steep mountainside a short distance east from the Barker claim of the Block P group. The Liberty group, together with 23 other patented claims in the Barker district, is owned by the Faith Mining Co., c/o C. B. Power, Helena, Mont., or T. J. Vaughn-Rhys, Monarch, Mont.

Four of the principal claims, the Liberty, Emerald, Dannie T, and Last Chance, partly overlap and embrace a comparatively small area. The Queen of the Hills claim is a short distance to the north of the other

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claims. The Marcelline and Annie E claims extend southward along Galena Creek. All of the claims were located in the early mining days. Little could be learned of their early history.

No production data for the years prior to 1913 are available. According to Weed (26), the Liberty mine was leased to the United Smelting & Refining Co. in 1897. At that time, two or three carloads of ore were produced weekly. Production from the Liberty group from 1913 to 1947, inclusive, is reported to have been 2,957 tons of ore, from which were recovered 102.61 ounces gold, 70,808 ounces silver, 13,313 pounds copper, 1,531,332 pounds lead, and 75,366 pounds zinc (13). Nearly half of the zinc reported was recovered from ore shipped by lessees who operated the Emerald claim in 1929. Most of the balance of this zinc was recovered from ore mined on the Dannie T claim by the Faith Mining Co. in 1946 and 1947.

According to Vaughn-Rhys, approximately 90,000 tons of ore averaging 6.5 percent lead, 10.0 percent zinc, 11 ounces silver, and 0.035 ounce gold a ton has been developed in the Liberty mine. About 4,500 tons of milling-grade ore has accumulated on the dump at the lower Liberty adit. Approximately 10,000 tons of ore is reported to be in various old dumps and as filling in stopes. The ore on the old dumps and the stope filling is reported to average 3 to 5.5 percent lead, 9 to 10 percent zinc, 8 to 11 ounces silver, and 0.03 to 0.04 ounce gold a ton.

The claims have been developed mainly by adits. Weed (26) reported that in 1897 two adits had been driven on the Liberty claim. A 190-foot inclined shaft connected the upper and lower adits. The ore shoot developed in the upper adit was 130 feet long. The length of the ore shoot in the lower adit was over 90 feet long. Since that time, several other adits have been driven at still lower altitudes on the Emerald and Dannie T claims. In recent years, the Faith Mining Co. has confined its work mainly toward developing the Liberty claim.

According to Vaughn-Rhys, the main vein averages 3 to 4 feet in width. It has a known length of over 3,600 feet. Three transverse or branching veins have been partly developed by drifts from the main adits. All of the veins occur in syenite porphyry near its contact with granite prophyry. The main vein strikes N. 60° to 80° E. and dips 50° to 60° SE. (26). The sulfide minerals are galena, sphalerite, marmatite, and pyrite, with small amounts of chalcopyrite and silver sulfides. The ore also contains rhodochrosite and small amounts of cadmium, arsenic, and antimony.

When visited in 1948 and 1949, several of the adits were open and in good condition. Most of the drifts and crosscuts were accessible.

Tiger, Moulton, and T. W. (Ag-Pb-Zn)

The Belfont, Harrison, Moulton, Pioneer, Tiger, and T. W. lode mining claims extend northeasterly up Galena Gulch from the Block P group. The first four of these claims were located by the Moulton Consolidated Mining

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Co. between July 1886 and September 1889; they comprise what was formerly known as the Moulton group. The Tiger claim was located June 18, 1884, by John E. Williams, et al. The T. W. claim was located May 30, 1884, by John M. Connolly.

The Moulton, Tiger, and T. W. claims were developed rapidly. According to MacKnight (12), at a depth of 230 feet the Tiger shaft encountered a 4-1/2-foot vein of galena containing 150 ounces silver a ton. Weed (26) reported the Tiger adit was 335 feet long in 1894; it was extended to a length of 550 feet by 1898.

The Moulton mine shaft was 100 feet deep in 1893 (16). Most of the development on the Moulton claim, however, was done by adit. The main adit was 1,232 feet long by 1898, of which 356 feet was driven as a crosscut to the vein (26). The Moulton and Tiger mines were equipped with steam hoists.

The T. W. mine was operated by the Ideal Mining Co. in 1892. At that time, the T. W. shaft was 140 feet deep. A 430-foot adit had been driven (12). The T. W. mine was leased to the United Smelting & Refining Co. in 1898. Lead ore produced was shipped to the company's smelter at Great Falls (26). Since the early-day company operations, only small-scale intermittent work has been done by lessees or by the owners. The T. W. claim is owned by Henry Croff, Monarch, Mont. The other claims are owned by Clendennin Mines, Inc., c/o John T. Nightengale, Boston, Mass.

Croff and Montague leased the upper workings of the Tiger and T. W. mines. During the summer of 1948, they are reported to have mined and shipped 60 tons of ore and fill material from old stopes, from which 339 ounces silver, 432 pounds copper, 21,422 pounds lead, and 11,637 pounds zinc were recovered (13). Lessees are reported to have mined 146 tons of lead-zinc ore from the Tiger claim in 1947 (20-1947). Weed (26) reported that about 1,000 tons of ore had been mined and shipped from the Tiger mine from 1893 to 1898. Ore production from the Moulton group during 1898 was approximately 3,000 tons. MacKnight (12) reported that over 400 tons of ore had been shipped from the T. W. mine before 1892.

The ore deposits on the Tiger claim occur as lenses in Barker porphyry and along a syenite-granite porphyry contact. The lenses mined were 5 to 6 feet wide but narrowed rapidly at depth (27). The main ore shoot averaged about 3 feet in width. It contained 30 to 40 percent lead and 18 to 20 ounces silver a ton (26). The ore deposits in the Moulton mine occur along a limestone-porphyry contact. The ore was argentiferous galena containing 20 to 40 ounces silver a ton (26). The ore deposits in the T. W. mine occur along the contact of a light-colored, fine-grained porphyry and a darker-colored coarse-grained porphyry. In the upper mine workings, lenses of ore were mined that occurred along the contact of porphyry with overlying limestone. The ore at the T. W. mine contains galena, sphalerite, and pyrite, with cerussite and smithsonite. The gangue minerals are quartz, calcite, rhodochrosite, and in places considerable clay.

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When visited in 1948, the Tiger and Moulton shafts and adits were inaccessible. The T. W. adit was open and in fair condition; the shaft was inaccessible.

May and Edna (Ag-Pb-Zn)

The May and Edna claims are about three-fourths of a mile north of the Block P mine and a short distance west of the Paragon and Carter mines. Both claims were located August 17, 1885, by J. T. Armington, et al. According to the report of the Inspector of Mines for Montana (9), the lower adit was 700 feet long in 1892. Weed (26) states that the claims were two of the principal producers in the Barker district during the early-day operations. The mine workings were inaccessible when visited by Weed in 1894 and 1897. As far as could be learned, no mining has been done since 1892. The claims have been owned for many years by the Faith Mining Co. No production records are available.

Development has been by several open cuts and shallow adits and the 700-foot adit crosscut mentioned above. From this main adit, drifts were driven along the contact of rhyolite porphyry with overlying Carboniferous limestone. The ore contains argentiferous galena, sphalerite, pyrite, and a small amount of chalcopyrite in a gangue of quartz and calcite. It occurs in lenses and as irregular bunches at or near the porphyry-limestone contact (27).

All of the old workings were inaccessible in 1949.

Dockter Kalloch (Ag-Pb-Zn)

The Dockter Kalloch claim is a short distance east of the Barker claim and north of the Liberty claim. It was located in September 1887 by the Queen Esther Mining Co. According to MacKnight (12), the property was operated by this company in 1892. Ore was produced and shipped from the Dockter Kalloch claim before the railroad was built; this ore paid freight charges of $52 a ton and netted the shippers $52.48 a ton. Since the early-day operations the mine has been worked at different times by lessees. Madge Houston and Mabel D. Raymond, Seattle, Wash., are the present owners.

No production records prior to 1917 are available. Available records show that the mine was worked intermittently on a small scale from 1917 to 1943. Total production during that period is reported to have been 133 tons of ore, from which 0.39 ounce gold, 4,004 ounces silver, 43 pounds copper, 63,156 pounds lead, and 4,143 pounds zinc were recovered. All of this gold, copper, and zinc is reported to have been recovered from a 13-ton shiptment made in 1933 (13).

Undgerground development consists mainly of two short adits driven on the vein from points high on the mountain on the east side of the canyon. During the early days, the ore was "rawhided" in deer skins down a steep trail. All underground workings were inaccessible in 1949.

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According to Law Thorson, Monarch, Mont., the ore occurred in small lenses along a syenite porphyry-rhyolite porphyry contact. The ore contained argentiferous galena, sphalerite, and pyrite.

Paragon (Ag-Pb-Zn)

The Paragon mine is on the side of the ridge east of the Kibbey Divide about 1 mile north of the old town of Hughesville. The claim was located January 28, 1889. It was operated by the Paragon Mining & Smelting Co. in 1891. By 1897 the mine had been developed by a 150-foot shaft and several hundred feet of drifts (26). Some good ore is known to have been produced, but no production records are available. For many years the claim was owned jointly by Elon Davis and Adolph Berger, Great Falls, Mont. Berger now is the sole owner.

According to Weed (26), the ore deposits on the Paragon claim occurred along the contact of rhyolite porphyry and limestone, usually in irregular masses and disseminations of galena, cerussite, sphalerite, marmatite, and pyrite. Except for small lessee operations in shallow workings, the property has been idle for many years. The shaft was inaccessible in 1949.

Carter (Ag-Pb)

The Carter claim is one of a group of nine patented claims one-half to 1 mile north of the Block P mine. Most of the claims were located in the 1880's. The Carter claim, owned in 1892 by Clifton and Zeigler, was optioned for $22,000 to E. J. Barker and John Sinclair (12). At one time Bruce Athey owned a half interest. Interests in other claims in the group formerly were held by Walter Kennedy, W. R. Harner, Adolph Berger, and Ford Brothers of Great Falls, Mont. The claims now are owned by the Hughesville Silver & Lead Mining Co. (Elon Davis and Minerva Davis, Great Falls, Mont.).

Some high-grade silver-lead ore was mined from the Carter claim during the first years of mining in the Barker district. Some of this ore was shipped to Swansea, Wales, for smelting; some ore was smelted locally at Hughesville and Clendennin. No production records are available.

The mine was worked through a 220-foot two-compartment shaft and a 200-foot adit, which in later years was extended to about 700 feet, including several short drifts.

According to Weed (26), the main deposit occurred at the contact of limestone and porphyry as a pipe- or chimney-shaped body. This deposit was said to have contained a body of galena 10 feet wide to a depth of 120 feet; it then widened within the next 100 feet of depth to 30 feet but became lower-grade and contained much iron pyrite and a little chalcopyrite and only 5 to 6 ounces silver a ton (27). Irregular bodies of galena, cerussite, sphalerite, marmatite, and pyrite occurred in limestone a short distance from the main deposit. These bodies were mined to shallow depth only. No commercial ore bodies were developed by the adit workings, although some small, irregular masses of pyrite were found.

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A zone of altered, brecciated material cut by the adit was reported to contain scheelite. Bureau of Mines samples taken in 1943 showed less than 0.01 percent tungsten trioxide. A zone 37 feet wide containing manganese minerals also was reported to have been crossed by the adit. A Bureau of Mines sample cut across a width of 20 feet in 1943 assayed 2.62 percent manganese.

When visited in October 1949, the adit was open and in good condition to its face. The shaft had caved around the collar.

Magnolia and St. Louis (Ag-Pb-Zn)

The Magnolia and St. Louis patented claims are on the southwest side of a heavily timbered ridge about three-fourths mile northeast of Barker.

The Magnolia claim was located July 1, 1887, by Jesse L. Henry, et al. The St. Louis was located later. Both claims were worked extensively before 1900, but little information regarding their history could be obtained. A three-fourths interest in the claims is owned by Adolph Berger, Great Falls, Mont. The other one-fourth interest is owned jointly by G. A. Harner, Seattle, Wash., and H. O. Vralsted and Cathryn Davis, Great Falls, Mont.

According to Weed (26), the St. Louis claim was being worked through a 200-foot adit in 1897. A Bureau of Mines engineer who visited the properties in 1942 reported the St. Louis claim had been developed extensively and that a few thousand tons of ore had been shipped. The Magnolia claim was developed by a 150-foot adit; only a small amount of ore had been mined.

According to Weed (26), the ore on the St. Louis claim contained 44 percent lead, 20 percent zinc, and 37 ounces silver a ton. No production records are available. Argentiferous galena, sphalerite, and pyrite occur in replacement deposits along or near the contact of limestone and granite porphyry. The contact extends northwesterly through both claims. The ore deposit averaged about 3 feet in width.

Blankenship (Ag-Pb)

The Blankenship mine is on the side of a small gulch near the head of the Dry Fork of Belt Creek about 3 miles east of Barker. It is owned by C. B. Powers, et al, Helena, Mont.

Three adits and one incline ranging from 50 to 300 feet in length have been driven to explore a mineralized zone in limestone. The workings aggregate about 1,000 feet in length.

The ore occurs principally in irregular pockets along bedding planes in limestone, which dips about 10° E. Occasional small filled fractures cross the bedding planes. The ore bodies range from 1 to 6 feet in thickness. An igneous dike about 12 feet wide cuts the limestone nearly at a right angle to the limestone bedding planes. Where exposed in the lower

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workings, the dike is altered almost completely to kaolin. Ore minerals are galena and cerussite in jasper.

One carload of sulfide lead ore was shipped in 1927 (20-1927). Data on the metal content of this ore shipment are not available. Most of the workings were accessible in 1948.

Forest (Lilly) (Ag-Pb)

The Forest was one of the first claims located in the district. It later became a part of the townsite of Clendennin. The claim was owned for many years by John T. Lilly. It is owned now by John J. Lilly and Robert Lilly, Monarch, Mont. Little development has been done; no ore has been shipped.

According to John J. Lilly, a vein 2 to 4 feet in width and containing narrow bands of galena and pyrite was explored by several open cuts, a 14-foot shaft, and a 30-foot adit. The vein cuts granite porphyry and shaly limestone near the limestone-porphyry contact on the east side of Galena Creek Valley. Three other narrow veins are reported. According to Lilly, a selected sample of ore from the shaft assayed $60 per ton in silver and lead.

The workings were inaccessible in 1948.

Other Properties

A number of other mining claims in the Barker district have been mentioned in publications and reports. Some of these claims are reported to have produced ore during the early days. All have been inactive for many years. The little information available on them has been briefed as follows:

Top Hand. - The Inspector of Mines for the State of Montana (9) reported that the mine was operated in 1889 and from 1890 to 1892. It was being operated in 1892 by the Paragon Mining Co. through a 400-foot adit. Some of the ore produced was shipped via the Missouri River to smelters at Kansas City and Omaha. Some ore was treated at Great Falls and East Helena. A nearly flat vein was stoped on both sides of the adit.

Silver Gulch. - The Silver Gulch mine is south of the Wright-Edwards mine near Barker. According to MacKnight (12), it was owned and operated by the Silver Gulch Mining Co. in 1892. Some ore was produced at that time.

Queen Esther. - According to Weed (26), the Queen Esther claim showed a quartzose vein containing a streak of galena that ranged from one-half inch to 6 inches in width. The strike of the vein was N. 80° E.; it dipped 50° to 55° SE. The vein followed the contact between syenite and granite porphyry. In 1897 the mine was developed by a 75-foot adit and a 95-foot adit. Four carloads of ore had been shipped up to 1898. In 1898 lessees produced enough development ore to pay expenses, although this development did not reach the main ore shoot (27).

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Dry Fork. - The Dry Fork Mining Co.'s group of seven claims was about 3 miles south of Barker. According to the Inspector of Mines for Montana (8), the claims were located in 1889, but little work was done until 1891. Most of the work then was done on the Etta claim, where an 85-foot shaft was sunk. A contract was let for sinking the shaft an additional 100 feet, but it is not known if it materialized. A vein containing a 12-inch band of galena was reported to have been encountered at the bottom of the 85-foot shaft.

Pride of the West. - The Price of the West is a patented claim partly in Judith Basin County and partly in Cascade County, about three-fourths of a mile northwest of Barker. Present owners are Elon Davis, Great Falls, Mont. (7/16); Adolph Berger, Great Falls, Mont. (7/16); and the Faith Mining Co., Helena, Mont. (1/8). The Inspector of Mines for Montana (8) reported that 10 tons of ore was shipped from the claim to the smelter at Wickes, Mont., in 1889. This ore netted $87 a ton. Thirteen sacks of ore sent to the smelter at Great Falls assayed 220 ounces silver and some gold. Weed (27) reported the claim had not been developed enough by 1897 to prove its value, although a small amount of ore had been produced.

Running Wolf District

The Running Wolf district, as considered in this report, includes that area on the northeastern slope of the Little Belt Mountains that is drained by Dry Wolf Creek, Running Wolf Creek, and Willow Creek (fig. 1).

The district is accessible from U. S. Highway 87 by county and unimproved side roads. From Stanford and Windham, these roads lead up Running Wolf and Willow Creeks. One improved Forest Service road, locally known as the "Bean Trail," extends up Dry Wolf Creek; it joins the Yogo Creek road at the mountain summit, from which point it leads westward and connects with U. S. Highway 89 at the top of Kings Hill. As a number of the mining claims are at high altitudes, they are accessible from the nearest road only by rough trails. These canyon and mountain roads are not maintained during the winter season.

The principal rock formations in the district are of sedimentary origin; the Madison limestone formation, of Carboniferous age, is the most extensive. Igneous rocks, chiefly syenite, syenite porphyry, and diorite porphyry, occur as dikes and sills. The principal igneous structure is a large extensive syenite dike or sill that extends northeastward across the district; it joins a mass of syenite porphyry, which Weed (26) named the Woodhurst stock. A diorite porphyry stock occurs about 4 miles west of the Woodhurst stock. These two igneous bodies are connected by a narrow dike or sill of syenite porphyry. A number of other smaller dikes and sills elsewhere have intruded the sedimentary formations. Most of the metallic mineral deposits occur in Madison limestone, usually at or near its contact with intrusive rocks (fig. 3). Ore production from the district has been small. Virtually all the properties have been inactive for many years.

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Woodhurst and Mortson (Ag-Pb)

The Woodhurst and Mortson property is about 5 miles above the mouth of the canyon on Running Wolf Creek. The two claims were surveyed for patent in 1888; they now are owned by Henry Croff, Monarch, Mont. Little historical information is available. Weed (26) reported that 500 tons of lead carbonate ore containing 65 percent lead and 30 ounces silver a ton was mined in 1889. Weed also reported the Woodhurst and Mortson mine to be the largest in the district. A small smelter was built and operated many years ago on Running Wolf Creek a short distance below the mine. It is said locally that the property at one time was leased to a doctor from Great Falls, Mont.; some high-grade lead carbonate ore was produced.

The mine has been developed by a 250-foot shaft with levels aggregating nearly 4,000 feet in length (26). When visited in 1948, all of the mine workings were inaccessible; no buildings remained.

According to Weed (26), the ore deposit is a contact vein 2 to 7 feet wide between limestone and syenite porphyry. As far as can be judged by an examination of the surface, it appears that the ore occurred in a brecciated zone in limestone near the igneous contact. The limestone beds strike east and dip south. Ore specimens found on the mine dump contain cerussite, galena, and pyrite in a silicified limestone gangue.

Yankee Girl (Ag-Pb)

The Yankee Girl claim is on the south side of Running Wolf Canyon about 1,000 feet above the creek level. It is owned by J. W. Leslie of Stanford, Mont.

The ore shoot occupies a fracture zone that conforms to the bedding of the enclosing Madison limestone, which here strikes northeast and dips 10° to 15° SE. The deposit appears to be at about the same stratigraphic horizon as the Woodhurst and Mortson deposit, three-fourths of a mile to the southwest. According to Leslie, the ore shoot ranged in thickness up to 6 feet. Only thin seams of ore 1 inch to 2 inches in thickness now are exposed in the workings.

A 100-foot incline driven on the dip of the ore shoot, with an estimated 200 feet of drifts therefrom, comprises the underground workings. The ore-bearing fracture zone has been explored along its outcrop for a few hundred feet by a number of small, shallow open cuts.

Ore specimens found in the dump at the incline consist mainly of galena and cerussite with small amounts of sphalerite and smithsonite. The gangue is calcite and jasper. Considerable amounts of lead carbonate with some galena, discarded by the former operators, still remain in the old dumps.

The mine was operated in 1894 by the father of the present owner. The ore was smelted at Great Falls. In 1921, lessees produced and shipped

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five carloads of lead ore. The metal content of these ore shipments is not known. Leslie reports that lessees shipped 2 tons of ore in 1932 that assayed 16 ounces silver, 44 percent lead, and 3.4 percent zinc.

When visited in 1948, the incline was accessible for about 75 feet. The workings from the incline had been back-filled with waste.

Sir Walter Scott and Mystery (Ag-Pb)

The Sir Walter Scott and Mystery claims are about 1-1/2 miles north of the Woodhurst and Mortson property. They are owned by Oswald and Claudia Lehman, Inglewood, Calif. At present the property is leased to Walter Lehman, Lewistown, Mont., who built a new road to it from Running Wolf Canyon in 1948.

The principal mine workings consist of a 75-foot inclined shaft and a 300-foot vertical shaft. All of these mine workings are inaccessible now. According to local reports, the vertical shaft encountered an underground lake, possibly a solution cave in limestone, and was abandoned. Drifting and crosscutting from both shafts probably did not exceed more than a few hundred feet in length. Weed reported that the vein so developed followed the contact of limestone and syenite porphyry and ranged from 2 to 5 feet in width (26). The quantity of the ore that may have been mined from these underground workings and its mineral composition and metal content are not known.

A flat-lying deposit overlying a basaltic sill has been exposed in a number of shallow pits and open cuts short distances to the north and south of the 300-foot shaft. This deposit is a replacement in limestone. No sulfide minerals could be observed in the ore. Malachite, azurite, cerussite, smithsonite, and probably some silver chloride and bromide occur in a gangue of quartz, calcite, fluorite, and iron oxide. A Bureau of Mines sample of ore selected from several of the pits in this flat-lying replacement deposit assayed 0.02 ounce gold, 65.5 ounces silver, and 0.05 percent lead.

In 1948 Walter Lehman shipped 12 tons of ore that came from several open cuts. Metals recovered from the ore amounted to 253 ounces silver, 102 pounds copper, 164 pounds lead, and 240 pounds zinc (13).

Mountainside and Last Chance (Ag-Pb)

Two patented mining claims, the Mountainside and Last Chance, are owned by E. D. Howe of Portland, Oreg. The claims are south of Running Wolf Creek, about a mile west of the Woodhurst and Mortson claims.

The property was worked last in 1937 by F. B. Snyder, Santa Barbara, Calif., M. F. Howe and E. T. Howe. The underground workings consist of three adits, which apparently were driven to explore a lead-silver deposit at the contact of limestone and an overlying minette sheet. Two of the adits, from which some ore appears to have been mined, are caved and entirely inaccessible. The third, slightly lower in altitude, is accessible; it penetrated the contact but encountered no ore.

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It was reported locally that silver ore valued at about $50,000 was produced during early operations. A small amount of lead-silver ore was shipped in 1922 (20-1922).

Christopher Columbus (Ag-Pb)

The Christopher Columbus claim is on the divide between the headwaters of Running Wolf Creek and Dry Wolf Creek at altitudes ranging from 7,000 to 7,500 feet. It is accessible only by trail. The claim was located in 1896 by Charles Lehman; it now is owned by Caroline Lehman, Lewistown, Mont.

The underground workings consist of three shafts, 80, 90, and 110 feet deep, and a 745-foot adit. The adit is about 500 feet lower in altitude than the shaft collars. Local reports are that there are about 1,000 feet of underground openings. All workings were inaccessible when visited in the fall of 1948.

According to Walter Lehman, son of the original locator, ore occurred on both sides of a minette dike cutting limestone near a syenite porphyry contact; the ore shoot continued in a shallow winze below the adit level.

No ore was observed in place, but a small amount of high-grade lead carbonate ore and some oxidized copper minerals and manganese oxides were found in some of the old dumps. No information on production is available other than a local report that a few tons of ore was shipped about 1901.

Pierce-Higbee (Dry Wolf) (Ag-Pb)

The three patented mining claims of the Pierce-Higbee group are owned by Frank J. Fiedler, Stanford, Mont. The claims are on the west slope of the ridge east of Lion Gulch, about half a mile above its junction with Dry Wold Creek Canyon.

The mine workings, consisting of several short, shallow adits, are caved and inaccessible.

The principal structural feature in the vicinity of the workings is a brecciated zone above the caved workings. The adit dumps contain small amounts of galena, cerussite, and chalcopyrite in a limestone gangue. A small amount of ore has been mined and shipped, but detailed records are not available.

Oscar Helsing (Ag-Pb)

Several unpatented claims on the north slope of Running Wolf Creek Canyon across from the Mountainside and Last Change claims are referred to locally as the Oscar Helsing property. The present claimant is unknown.

The mine workings, which comprise several near-surface adits and several shallow shafts, are caved and inaccessible. The extent of the

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underground workings is not known, but, judging by the size of the dumps, they are not extensive.

The property was equipped at one time with a small gravity-type mill powered by a gasoline engine. According to William Rauscher, a nearby cattle rancher, the mill was built by Oscar Helsing, who operated it for a short time only.

The ore appears to have occurred in pockets in limestone at the contact with a syenite dike or sill. The trend of the contact is east; the dip is to the south. Scattered ore fragments in the dumps contain small amounts of galena and cerussite. Gangue minerals are iron oxides, quartz, and calcite.

Bessie (Seiden) (Ag-Pb)

The Bessie claim is in Running Wolf Creek Canyon a short distance northwest of the Mountainside and Last Chance claims. It is known also as the Seiden claim, after the former owner, J. W. Seiden, Lewistown, Mont. Later, it was located and held by the late John Grensten, Stanford, Mont.

Many short adits ranging in length from 10 to 50 feet have been driven to explore small fractures in limestone. Most of the workings are caved, but the two adits most recently driven were accessible during the fall of 1948. One of these follows a stringer containing galena in a limestone fracture. The stringer ranges in width from half an inch to 1-1/2 inches. It strikes northeast and dips 60° SE. No ore has been shipped.

Hans Setter (Ag-Pb)

Three unpatented mining claims comprise the Hans Setter group held by location by Walter Lehman of Lewistown, Mont. Information concerning the property was provided by Lehman. The claims are on the South Fork, or Galena Branch, of Running Wolf Creek about a mile south of the Mountainside claim.

The claims were located in the early mining days but were abandoned after they had been explored by a few shallow shafts and near-surface adits. No record is available of any production that may have been made at that time. Lehman relocated the claims about 1937 and shipped 7 tons of ore sorted from the old dumps.

The ore deposit occurs as a replacement in limestone near the contact with syenite porphyry. The ore contains argentiferous galena, pyrite, and a small amount of sphalerite in a quartz and calcite gangue.

Running Wolf Iron (Fe)

A number of iron-ore deposits, extending westward for 6 miles along the northeastern flank of the Little Belt Mountains, are collectively

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referred to as the Running Wolf iron deposits. The deposits are covered by 43 patented mining claims held by numerous owners.

The individual deposits are isolated from each other by deep canyons that have been developed by northward-flowing streams. Altitudes range from 5,000 to 7,000 feet. The deposits are accessible from Stanford, Mont., on the Great Northern Railroad and U. S. Highway 87, by 14 to 16 miles of improved county road that skirts the Little Belt Mountains; thence by 2 to 3 miles of mountain roads or trails that lead up the various canyons.

Iron ore first was discovered in the Running Wolf area more than 60 years ago. Many of the mining claims were located as early as 1887. A few short adits and shallow shafts constitute the underground workings. No iron ore shipments have been made from any of the claims.

The U. S. Geological Survey made a reconnaissance survey of the Running Wolf iron deposits during the summer of 1943. Geologic and topographic maps of the eastern end of the iron-bearing area between Willow and Running Wolf Creeks were prepared, on which the most favorable deposits were indicated. During the following fall and winter, the U. S. Bureau of Mines investigated 4,000 feet of the limestone-porphyry contact at its eastern end by diamond-drilling and surface trenching. Twenty-eight trenches were excavated. Four holes ranging in length from 111 to 214 feet and with a combined length of 600 feet were drilled (15). Bureau of Mines investigations partly delimited two lenses of iron ore. The east lens is about 500 feet long and averages 5 feet in width. The west lens is about 1,100 feet long; it averages 15 feet in width (fig. 5).

The iron-ore deposits occur as replacements in Madison limestone along the contact with syenite porphyry. The ore is a fine-grained, intimate mixture of magnetite and hematite with a minor amount of limonite. Magnetite predominates. The principal gangue mineral is calcite. Crystals of pyrite were found in one trench; pyrite casts were found in the core from one drill hole. Copper carbonate stains were noted in another trench, but analyses showed the copper content of the ore to be only 0.02 percent. Analyses for titanium showed as much as 0.04 percent TiO_2 but averaged less than 0.01 percent. Indications are that the iron ore has been formed from primary sulfide-bearing magnetite, the iron sulfides having been oxidized to hematite and limonite. None of the diamond-drill holes, however, were drilled deep enough to penetrate the unoxidized primary zone. The average analysis of the ore indicated by the work done by the Bureau of Mines is 58.75 percent iron, 0.109 percent sulfur, 0.02 percent phosphorous, and 9.53 percent insoluble (15).

Three other deposits of iron ore are known to occur along the limestone-porphyry contact to the west of the area investigated by the Bureau of Mines. Float ore and ore on the old dumps indicate that these deposits are similar to those investigated at the eastern end of the contact. Iron ore also has been reported to occur near Sage Creek, about 2 miles south of the area investigated by the Bureau of Mines in 1943. Investigations made at Sage Creek in 1948 revealed only a few outcropping narrow lenses

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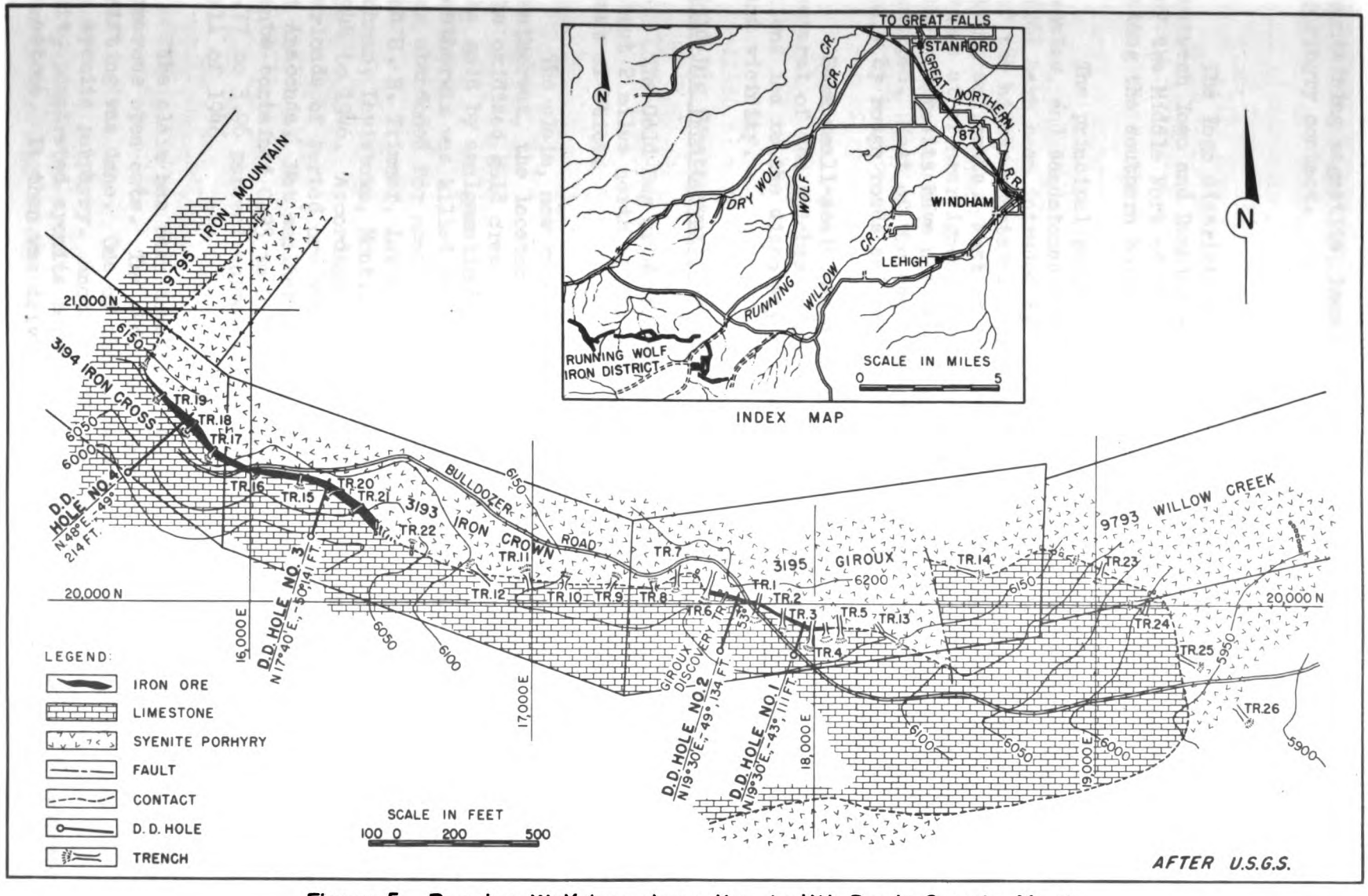

Figure 5. Running Wolf iron deposits, Judith Basin County, Mont.

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containing magnetite, hematite, and limonite in limestone along a syenite porphyry contact.

Yogo District

The Yogo district includes the area south and east of the divide between Yogo and Running Wolf Creeks and the area around the headwaters of the Middle Fork of the Judith River as far south as the main divide along the southern border of the county (fig. 1).

The principal rocks of the district are sedimentary. Limestones, shales, and sandstones ranging in age from pre-Cambrian to Carboniferous (26) have been intruded by igneous rocks, which form the cores of most of the higher mountains. Erosion has removed a large part of the overlying sediments. Most of the metallic mineral deposits occur in limestone at or near igneous contacts (fig. 3). With but few exceptions, these deposits have not been developed extensively; little ore has been shipped. Most of the deposits are at high altitudes. They are accessible only by rough roads and trails during the summer and early fall.

Some small-scale placer mining was done during the early days in several of the gulches on the east side of the mountains. These operations led to the discovery of the sapphire-bearing dike in Yogo Gulch and vicinity.

Gold Bug (Weatherwax) (Au-Cu)

The Gold Bug or Weatherwax mine is on the west side of Skunk Gulch about 2 miles north of the old town of Yogo, or approximately 23 miles west of Utica.

The claim, now known as the Gold Bug, was located in the early 1880's. Weatherwax, the locator, constructed an arrastre near Skunk Creek to treat the oxidized gold ores. He later built a five-stamp mill and recovered the gold by amalgamation. According to Charles Goyins, Stanford, Mont., Weatherwax was killed by falling from a trestle near the mill. The claim was abandoned for many years. It was relocated about 1930 by Carl Nordberg and H. R. Trimmer, Lewistown, Mont. Several adits were driven. Walter G. Lehman, Lewistown, Mont., leased the claim in 1937; he worked it from 1944 to 1946. According to smelter statements furnished by Lehman, 14 carloads of sorted ore weighing 508.52 tons were shipped to the smelter at Anaconda. Net smelter returns amounted to $6,002.81. The ore shipments contained 0.23 to 0.74 ounce gold, 0.37 to 6.6 ounces silver, and 0.77 to 3.96 percent copper a ton. The property has been idle since the fall of 1946.

The claim has been developed by three adits, a shallow shaft, and numerous open cuts. The shaft was sunk in the oxidized outcrop. Some drifting was done. One of the adits was driven west a short distance in syenite porphyry. Another adit, nearly at right angles to the lower adit, penetrated syenite porphyry for about 100 feet, where it entered limestone. It then was driven westward in the limestone. The third adit,

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used as a main haulageway, was driven westward, then northward, in limestone. It crossed and recrossed a narrow minette dike before the ore deposit was encountered. The deposit was drifted on for approximately 100 feet to the west of the main adit drift and approximately 60 feet to the east. A short crosscut to the south connects with the second adit. Some stoping was done above the east drift. The underground workings aggregate about 1,200 feet in length. Approximately 300 tons of milling-grade ore is on the dump near the main adit portal.

The ore bodies occur as irregular replacements that roughly follow the bedding planes in limestone, which overlies syenite porphyry. The limestone generally dips 15 to 30 degrees toward the south. The continuity of the beds, however, is interrupted by small eastward-trending faults, along which blocks of limestone have moved vertically. The resulting displacement has made development and mining difficult.

The ore minerals are mainly auriferous pyrite and chalcopyrite with minor amounts of copper oxides and carbonates. Secondary silver minerals may be present.

When visited in 1948, the shaft was inaccessible. The lower adit and the upper main haulage adit were in good condition. The middle adit was closed by a cave about 80 feet from the portal.

Blue Dick (Cu-Au-Fe)

The Blue Dick property of three patented claims is on the west slope of Elk Gulch about 2-1/2 miles east of Yogo Peak. It is accessible by a side road from the Forest Service road in Elk Gulch.

The claims were located in 1878 and patented in 1892. They were mined for gold in 1893. The ore was treated in an arrastre at the settlement of Yogo (6). Copper carbonate ore is reported to have been mined from the upper workings and shipped. No production data on the early-day operations are available. A small amount of ore was shipped by the Blue Dick Mining Co. in 1941. Company operation on a small scale continued during the following 6 years. A 50-ton gravity-flotation mill was erected during 1943 in Elk Gulch about one-quarter of a mile southeast of the mine and about 500 feet lower in altitude. A surface tram was built between the lower mine adit and the mill; it proved unsatisfactory. A road then was constructed over which the ore was hauled by truck to the mill. From 1937 to 1946, inclusive, production was 702 tons of ore and concentrate, from which were recovered 329 ounces gold, 3,231 ounces silver, and 23,667 pounds of copper (13). Ownership of the property is divided: The Blue Dick Mining Co., Dr. Symonds, president, Miles City, Mont., has a one-sixth interest; Ole Johnson and Walter Jensen, Great Falls, Mont., hold a two-thirds interest; and Albert Hjort, Great Falls, Mont., holds a one-sixth interest.

The mine workings consist of two adits and an open cut (fig. 6). The lower or main adit, at an altitude of 7,410 feet, is 400 feet long; it is open and in good condition. The upper adit is reported to be about 325

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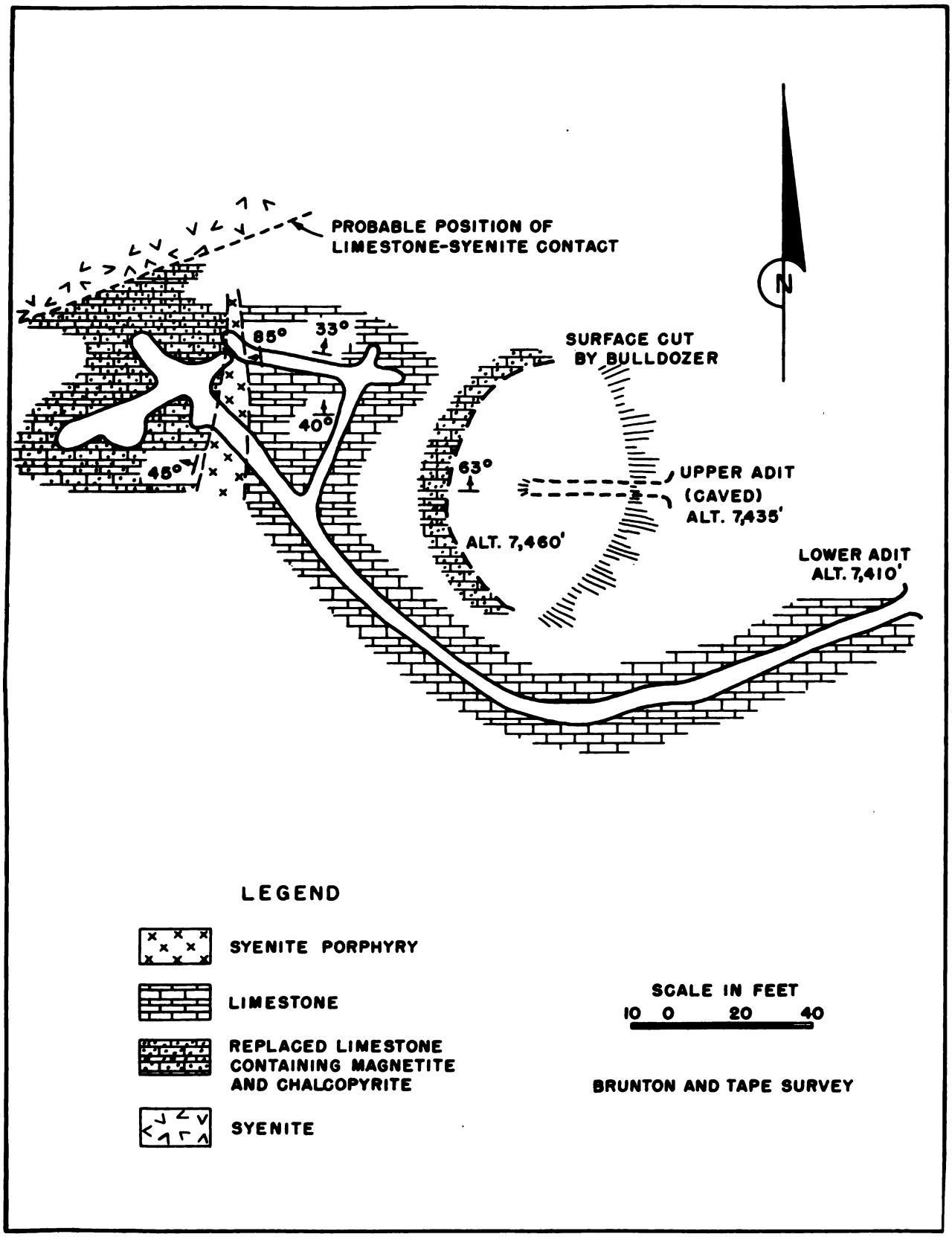

Figure 6.—Blue Dick mine, Judith Basin County, Mont.

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feet long. Much of it has caved, but some of the upper workings still are accessible through raises from the lower adit.

The ore deposit occurs in Madison limestone at the contact with syenite porphyry. It is a contact metamorphic deposit, irregular in form. It is reported to have been crosscut in the upper adit for a distance of 38 feet (6). The syenite contact has not been reached in the lower adit, but the ore deposit has been exposed there for a horizontal distance of 35 feet as measured at right angles to the probable strike of the limestone-syenite contact. The contact appears to dip about 45° NW. A syenite porphyry dike, as exposed in the lower adit, cuts the deposit (fig. 6).

The ore consists mainly of magnetite. Pyrite and chalcopyrite, with which the gold apparently is associated, are conspicuous. Small amounts of scheelite and molybdenite also are present.

Six Bureau of Mines samples of the ore exposed in the lower adit were taken in 1948. Analyses are reported as follows:

Sample length, feet	Analyses					
	Ounce per ton		Percent			
	Au	Ag	Cu	Fe	Mo	WO_3
5	0.08	0.50	1.5	22.2	0.06	0.01
8	.04	.22	1.0	38.7	Nil	.01
5	.06	.32	1.2	60.0	0.04	.02
8	.09	.47	1.2	56.1	.01	Nil
6	.05	.47	1.3	54.1	4.11	Do.
6	.05	.35	.9	24.4	.09	Do.

California (Harriet) (Au)

The California or Harriet is an unpatented claim near the top of the ridge east of Elk Gulch, about one-half mile south of the divide between Elk Gulch and Lyon Gulch. It was located in the early 1880's as a gold prospect. According to Weed (26), the claim was worked in 1897 by Louis Pepin, R. Giroux, and Joseph Sutler for the Judith Valley Mining & Milling Co. At that time, a 50-foot shaft was sunk on a vein reported to contain $7 a ton in gold. The claim was abandoned after considerable development had been done. It was relocated as the Harriet claim by Harry F. Goll, of Milwaukee, Wis., in 1942 or 1943. The adit was reopened; the old workings were sampled. Since then, the property has remained idle. No production has been reported.

The claim was developed by several open cuts, a 50-foot shaft, and a 150-foot adit, which connected with the bottom of the shaft. About halfway in this adit, a crosscut was driven northeastward for about 100 feet.

The ore found in the shaft is reported to contain free gold. The ore occurs in narrow silicified zones or bands on each side of a minette dike that cuts syenite porphyry and the overlying limestone. The dike ranges in width from 2 to 4 feet; it strikes east and dips nearly vertical.

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Altered syenite on the dump at the adit portal contains small, irregular masses and coatings of honey-yellow garnet and pyrite with minor amounts of lead, zinc, copper and iron carbonates, and oxides. Bureau of Mines samples of this material showed that it contains 0.05 to 1.0 percent lead, 0.05 percent zinc, 0.01 ounce gold, and a trace silver.

When visited in 1948, the surface cuts had sloughed. The shaft was in poor condition and inaccessible. The main adit was in fair condition and accessible to the shaft.

Sarsfield (Cu-Au-Fe)

The Sarsfield, Ben Franklin, and Sheridan claims are on the ridge between Bear Gulch and the upper north branch of Yogo Creek about 1-1/2 miles east of Yogo Peak. The claims are approximately 24 miles southwest of Stanford.

The claims were located in the 1880's. A small amount of development, consisting of surface cuts and trenches, was done at that time. After being abandoned for many years, the claims were relocated about 1914 by A. J. Stough, H. R. Trimmer, and others. A 70-foot shaft was sunk on the deposit. A 30-foot crosscut at the 60-foot shaft level cut a mineralized zone about 14 feet wide. Drifts were driven along both sides of this zone. These drifts extended about 50 feet north and 50 feet south from the crosscut. To develop the deposit at greater depth, a 450-foot adit was driven into the ridge about 200 feet lower in altitude than the shaft collar. This adit penetrated hard syenite porphyry and diorite porphyry for its entire length.

The claims again were abandoned. They were relocated in 1940 by C. R. Goyins, Stanford, Mont., and H. R. Trimmer, Lewistown, Mont. A short adit drift was driven on a narrow vein in limestone on the Sheridan claim about 300 feet southeast of the Sarsfield shaft and about 100 feet lower in altitude. According to Goyins, a small amount of copper ore was shipped from the Sarsfield claim during the early operations; no production data are available.

The ore deposits occur as replacements in limestone at or near the contact with syenite porphyry. Erosion has exposed the deposits along the west side of the ridge where, they appear as lenses and irregular masses. Magnetite, pyrite, chalcopyrite, malachite, cuprite, and chrysocolla, with small amounts of chalcocite and bornite, are the principal ore minerals. A Bureau of Mines sample taken from the 60-foot shaft level in 1943 assayed 0.035 ounce gold, 0.25 ounce silver, 0.99 percent copper, and 0.01 percent tungsten trioxide.

When visited in 1948, the shaft was inaccessible. The 450-foot adit was accessible to its face. The short adit drift on the Sheridan claim was accessible for its entire length.

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Finlander (Cu-Fe)

The Finlander group of six patented mining claims is on the north slope of Yogo Peak about 2 miles west of Yogo Pass. The claims were located about 1900 and patented in 1919. No records of any production are available. The group is owned by the Commonwealth Mining Co. of Butte, Mont.

The underground workings consist of a 600-foot adit and a 96-foot shaft. These workings are at an altitude of about 8,000 feet. All were inaccessible when visited in 1948.

The mountain slope in the vicinity of the workings is deeply covered with talus, mainly of syenite. Material in the mine dumps indicates that the deposit is a contact metamorphic replacement in limestone near the syenite contact. The ore deposit is stated to range from 20 to 28 feet in width. The ore consists mainly of magnetite containing irregular veinlets and disseminations of pyrite and chalcopyrite.

New Deal (Cu-Au-Fe)

The New Deal property, consisting of several unpatented claims, is a short distance northeast of the Blue Dick mine. The claims were located many years ago. A large amount of development was done, and a small gravity-type mill was constructed. The property was abandoned but later was relocated. It now is held by Ole Coleman, Stanford, Mont.

Development consists of six adits of unknown length. All of the adits penetrated loose surface debris for considerable distances before reaching solid rock. Four of the adits now are closed by caving at short distances from their portals. Two adits, still partly accessible, penetrate altered, shaly limestone before entering soft, kaolinized syenite porphyry.

Material on the dump at one of the adits indicates that the ore consists mainly of magnetite, pyrite, and chalcopyrite. Goodspeed (6) reports the presence also of small amounts of molybdenite, scheelite, brown garnet, green epidote, and finely granular, white wollastonite. According to Coleman, a small amount of concentrate was shipped by former owners when the small mill first was operated. The ore was valued mainly for its gold content. No production data are available.

Sweepstakes (Ag-Pb)

The Sweepstakes claim is near the head of the West Fork of the Lost Fork of Judith River, 10 miles south of Yogo Peak. Marvin Corkill, postmaster at White Sulphur Springs, Mont., located the claim some years ago but later abandoned it.

Mine workings include an adit reported to be 300 feet in length and a shaft, 20 to 30 feet deep. The shaft has caved. The adit is accessible for about 75 feet from the portal.

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A 308-pound sample of sorted ore from the shaft was shipped by Corkill; it assayed 0.01 ounce gold, 114.2 ounces silver, 59.7 percent lead, and 0.05 percent copper. Other small shipments of ore are reported to have been made, but details are lacking.

A conspicuous high cliff of Madison limestone, known locally as the Chinese Wall, extends eastward for several miles. This limestone overlies a soft, yellow, shaly limestone formation of Devonian age. Cerussite and galena in the form of nodules and small masses occur irregularly in this shaly limestone within an area of about 1 acre. Large blocks and fragments of unaltered blue Madison limestone form a heavy talus, which covers much of the mineralized shaly limestone. The 300-foot adit started and driven through heavy talus entered soft, shaly limestone containing some cerussite. This adit now is caved about 75 feet in from its portal, where the shaly limestone was found. A Bureau of Mines sample of this caved material assayed a trace of gold, 1.72 ounces silver, and 0.7 percent lead.

Leonard (Ag-Pb)

The Leonard No. 1 and No. 2 claims are approximately 14 miles northeast of Kings Hill via the Forest Service trail from Kings Hill to Yogo Peak. They are about half a mile south of the main trail and about 1 mile southwest of the Yogo Peak lookout tower.

The claims were located by Joe Boucher, Havre, Mont., and Paul Vdovic, Neihart, Mont., in July 1949. The area formerly had been located but abandoned. No ore has been shipped. Little work has been done.

A quartz vein containing bunches and disseminations of argentiferous galena occurs along the south side of a 10-foot syenite prophyry dike which cuts flat-lying limestone. Where exposed in an open cut, the vein is 8 to 15 inches wide. It strikes N. 80°-86° E.; the dip is vertical. An 18-foot adit 55 feet below the open cut has been driven along the limestone-porphyry contact. About 1 ton of ore is on the dump at the open cut. It contains galena, sphalerite, and pyrite. A Bureau of Mines sample of this ore assayed 0.005 ounce gold, 83.6 ounces silver, 22.9 percent lead, and 0.1 percent zinc.

Boucher and Vdovic constructed a bulldozer road to the lower adit from the Forest Service trail in August 1949. A gasoline-powered hoist equipped with cables and a small scraper was at the portal of the lower adit. Preparations were being made to extend this adit eastward under the open cut.

Weatherwax and King (Lenny) (Au-Fe)

The Weatherwax and King mine, also known as the Lenny, is on the east side of a long ridge extending south from the west end of Grendall Mountain about 3-1/2 miles east of Kings Hill. It is in an area at one time known as the Judith Mountain district. The property consists of the Valley and five other patented claims. They were located in the

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1880's by Weatherwax and King, who constructed an arrastre and worked the mine for gold. The claims were acquired later by a Lewistown, Mont., bank. Eventually they were purchased by Daniel Lenny. The Lenny heirs are the present owners.

According to Carl Faller, Neihart, Mont., most of the development, consisting mainly of a 150-foot shaft and a long adit, was done during the early days. Later, Johnson and Nelson sank a 20-foot shaft with about 50 feet of drift therefrom and drove a 20-foot adit crosscut. No production records are available. When visited in 1949, all of the old workings had caved or otherwise were inaccessible.

The ore deposits occur as replacements in limestone at or near the contact of syenite prophyry. The main deposit is in the form of a pipe or chimney. Material on the old dumps indicates that only the oxidized ores were exploited. This ore consists of soft yellow limonite and hard, rounded masses composed mainly of iron oxides. The gangue is quartz and silicified limestone. A Bureau of Mines sample of selected hard ore found on the dump of the shallow shaft assayed 0.005 ounce gold, 0.05 ounce silver, 0.05 percent lead, 50.7 percent iron, and 14.2 percent insoluble.

Bourke-Larson (Au-Cu-Pb)

The Bourke-Larson prospects are on the crest and east side of Prospect Ridge about half a mile south of the lookout tower on Yogo Peak, approximately 30 miles southwest of Stanford. A number of claim locations extend eastward along the south side of Yogo Peak from Prospect Ridge to Lake Elva.

The area has been located and relocated several times since the early 1880's. The claims now are held by location by Fred Bourke, Lewistown, Mont., and Rudolph Larson, Windham, Mont.

The western claims cover an area of flat-lying limestone cut by narrow basic dikes. Galena is disseminated in altered limestone at and near the north side of one of the narrow dikes where several short trenches have been dug. No ore has been shipped.

On the east side of Prospect Ridge, a syenite porphyry dike or sill cuts the limestone beds; it is about 10 feet thick. It strikes northwestward and dips about 30° SW. The decomposition and weathering of this dike has formed a residual gold deposit. Free gold in the form of small, rough grains and nuggets occurs in the weathered prophyry at the top of the ridge over an area of about half an acre. This deposit has been placer-mined intermittently on a small scale by several prospectors. Lack of water for sluicing has handicapped these operations. At one time, 4,000 feet of 4-inch pipe line was installed to bring water from springs west of Yogo Peak. According to Bourke, the pipe line was used for only about 4 hours. During that time, he reports that more than 8 ounces of gold was recovered in a narrow sluice box about 50 feet long.

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A 100-foot adit was driven through surface debris and broken limestone to the limestone-porphyry contact a short distance northeast of the placer workings. Numerous small trenches and open cuts also were excavated. A shaft, said to be 100 feet deep, was sunk through limestone to the dike at a point about 300 feet south from the surface workings. According to Larson, a few tons of low-grade oxidized gold ore was mined.

A narrow quartz vein containing scattered small amounts of pyrite, chalcopyrite, malachite, chrysocolla, and azurite extends eastward in the syenite porphyry on the southeastern side of Yogo Peak. An open cut was excavated in the outcrop of this vein at a point high on the steep mountainside west of Lake Elva. A long adit was driven west from near the side of the lake in an unsuccessful attempt to intersect the vein at a lower altitude.

When visited in 1948, the shallow adit at the placer workings was accessible to its face. The shaft was caved at the collar. The adit west from Lake Elva was closed by a cave at the portal.

Della and Quaker City (Ag-Pb-Au)

The Della and Quaker City claims are on the divide between Elk and Lyon Gulches. According to Weed (26), the claims were worked intermittently from 1892 to 1894. Development consisted mainly of a 40-foot shaft and several adits. In 1893 an adit drift was driven for 300 feet alongside a minette dike, where free gold was said to be present in a 2-inch to 3-inch band of altered contacting limestone. No production has been reported. In 1948 all of the workings were inaccessible.

Other Properties

The following properties were not investigated during 1948 or 1949. The little information available has been briefed from available publications and reports as follows:

T. C. Power (Au). - The T. C. Power claim is on a ridge between Elk Gulch and Skunk Creek about half a mile south of the Gold Bug claim. It was located many years ago. Several hundred tons of low-grade gold ore was hauled to an arrastre near Yogo townsite for treatment (26). Leeson (10) reported that the arrastre was owned and operated by Elias Shelby, and that the arrastre had two "tubs," which were operated by an overshot water wheel. The ore treated consisted mainly of brown iron oxides; it contained $10 to $40 a ton in free gold. Available information indicates that the deposit is in syenite porphyry, but no mention is made as to its character and extent.

Little Emma (Au). - The Little Emma claim is on the ridge west of Lead Gulch and west of the Blue Dick mine. Weed (26) reported that the claim was developed in 1897 by two 28-foot shafts and a 300-foot adit. The adit was driven 12 feet wide. This adit crosses a limestone-syenite porphyry contact, where a deposit contains auriferous pyrite. The ore has been reported to contain $17 a ton in gold; it is not free milling. No production is of record.

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M & M (Mn). - The M & M group includes 12 unpatented lode-mining claims named and numbered M & M No. 1 to M & M No. 12. It is about 12 miles southwest of Stanford, Mont. The claims were located about 1942. Little work has been done. No ore has been shipped.

The claims were examined by a Bureau of Mines engineer in 1942 for their manganese possibilities. He reported that only one deposit is exposed; it is on the M. & M No. 1 claim. This deposit occurs at the contact of limestone and syenite porphyry. The limestone has been eroded away in some of the nearby gulches, exposing the syenite porphyry. A Bureau of Mines sample taken from a 3-foot thickness where exposed in a shallow pit assayed 6.4 percent manganese and 22.12 percent iron.

San Miguel District

The unorganized San Miguel district is 3 to 5 miles south of the Barker district (fig. 1). It embraces an area of about 4 square miles. Altitudes within the district range from 6,000 to 7,000 feet. The San Miguel group of claims, covering virtually all of the known metallic mineral deposits in the district, are accessible by a poor-quality mountain road that leads from the Barker-Monarch road at a point about half a mile south of Barker.

Metallic mineral deposits were discovered in the district about 1881 by miners and prospectors traveling between Neihart and Barker. Considerable work was done between 1881 and 1886 toward prospecting and exploring the deposits. No records are available on any production that may have been made at that time. One carload of lead-zinc ore is reported to have been shipped in 1927. Other than some assessment work, nothing has been done in recent years.

Hornblende schists are the predominant rock formations (fig. 3). According to Weed (27), the schists are of Archean age and are a part of a complex of various rocks. A number of pegmatite dikes in schist are exposed mainly in the form of bold quartz outcrops. These pegmatites contain mica and are reported to contain some beryl. Galena, sphalerite, and pyrite occur irregularly along fractures in hornblende schist, some of which is irregularly bleached and altered.

San Miguel (Pb-Zn)

The Faith Mining Co., T. J. Vaughn-Rhys, manager, which also owns the Liberty group in the Barker district, acquired the San Miguel group of about 60 unpatented mining claims in 1923. The mine camp, consisting of several log cabins, is about centrally located in the group at an altitude of about 6,300 feet. It is accessible by 4 miles of rough mountain road from the Barker-Monarch road.

The mine workings include 11 adits reported to range from 50 to 500 feet in length, and several shallow shafts. The aggregate length of all of the underground workings is said to be several thousand feet. When visited in the fall of 1948, the upper San Miguel adit, about half a mile

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south of the camp, and the San Marcos adit, about half a mile north of the camp, were the only accessible workings.

The upper San Miguel adit was driven north in hornblende schist for a distance of about 200 feet. The first 65 feet is in an irregular zone of bleached schist that is sparsely mineralized with scattered crystals of galena, sphalerite, and pyrite. The hanging wall of the bleached zone strikes N. 75° W. and dips 25° NE. Similar mineralization is exposed in a small pit near the portal of the adit. A lower adit driven about 250 feet below the upper adit was caved. The size of the dump indicates that the workings from this adit were more extensive than those of the upper adit, but no ore minerals were in evidence.

The San Marcos adit is about 100 feet long; it is in hard hornblende schist. A narrow stringer containing galena is exposed near the face of the adit; it strikes N. 5° E.

One carload of lead-zinc ore is reported to have been shipped in 1927 (20-1927). According to Vaughn-Rhys, this ore shipment averaged 0.70 ounce gold, 18.0 ounces silver, 51 percent lead, and 3.0 percent zinc a ton.

GOLD PLACERS

Small-scale, intermittent gold placer-mining operations have been conducted in many of the gulches on the east side of the Little Belt Mountains since 1879, when the first placer gold was mined in Yogo Gulch. The operations generally were unprofitable and soon were abandoned. Gold placers were worked in Yogo Gulch and its tributaries for 6 miles above and the same distance below the old town of Yogo (11). Considerable placer mining was done in Lyon and Iron Gulches, upper tributaries of Dry Wolf Creek (11). According to Mrs. Elva Wineman, Stanford, Mont., her father worked gold placers in Silver Gulch on the north side of Yogo Peak. Some placer mining also was done along the South Fork of the Judith River.

The placer gold recovered from the gravels along Yogo Creek was reported by Weed (26) to have been "bright and clean, without quartz, rather rough, and in flattish grains." Placer operations in this locality led to the discovery of the Yogo sapphire deposits.

Lyden (11) states that it is improbable that the total gold production from the placers in the areas later included in Judith Basin County exceeded $5,000 in value. Since 1920, when the county was formed, the recorded production of placer gold in Judith Basin County has amounted to only 21.12 fine ounces (13).

NONMETALLIC MINERAL DEPOSITS

Judith Basin County contains numerous nonmetallic mineral deposits of a wide variety, including sapphire, gypsum, limestone, bentonite, building stone, sand and gravel, and pegmatite deposits containing mica

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and beryl. The sapphire-bearing deposits in the Yogo district were productive from 1897 to 1929. Gypsum was mined and calcined mainly in the vicinity of Kibbey many years ago. A small amount of limestone has been mined for use at a former small smelter and for lime production for local use only. A little bentonitic clay has been mined at times by local ranchers for use in lining irrigation ditches and reservoirs. Sand, gravel, and crushed rock are produced intermittently for local construction purposes. With the exception of sapphire, the production of nonmetallic minerals in Judith Basin County has been of little consequence.

Sapphire

New Mine Sapphire Syndicate (Yogo Sapphire)

Sapphire was discovered in the bench and stream gravels near Yogo Gulch, about 11 miles southwest of Utica, Mont., in 1894 and 1895 by G. A. Wells, S. S. Hobson, Matthew Dunn, and J. Hoover (2). These men were prospecting for placer gold. In mining the placers for gold, a bluish material was retained in the sluice boxes; it was at that time unidentified. According to Weed (26), the season's gold placer cleanup amounted to $700 worth of gold. A cigar box full of this bluish material was shipped to Tiffany's, New York, in November 1895; it netted the shippers about $1,800.

In February 1896, James Ettien, a sheepherder, noticed sapphire in the piles of dirt around gopher and badger holes along the outcrop of an igneous dike east of Yogo Creek. This led to mining sapphire from the minette or lamprophyre dike. For recording the first claim, Ettien gave a half interest in it to Clarence Goodall (4). The New Mine Sapphire Syndicate, London, England, purchased the claims in that immediate area in 1897.

The New Mine Sapphire Syndicate first mined along the outcrop of the sapphire-bearing dike by manual methods. The hand-excavated material was hauled in wagons to a ditch for washing (28). A shaft was sunk to a depth of 60 feet in 1897. The soft, altered dike became harder at a depth of about 60 feet below the surface. In order to disintegrate and wash this material, it was spread out over large board and concrete platforms to weather and soften. It then was put through sluice boxes equipped with strap-iron riffles. The recovered rough sapphire concentrate, containing a small amount of pyrite, was put through electromagnetic separators to remove the pyrite. The final concentrate was hand-sorted. The larger sapphires of first quality were shipped to London, England, for cutting. The small and second-quality stones, the lower-quality stones, and the fine grit or "gleanings" were shipped to London and marketed for watch jewels, instrument bearings, and abrasives.

The New Mines Sapphire Syndicate purchased the holdings of the American Sapphire mine at the west end of the dike in August 1914 for a reported price of $80,000 (19). The Syndicate did not operate the American Sapphire mine. It operated its original holdings until 1929, when all sapphire mining ceased. The 60-foot shaft at the New Mine

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Sapphire Syndicate mine had by that time been sunk to a depth of 250 feet. The 100-foot shaft level was driven west in the dike for about 2,300 feet and about 700 feet to the east. The 250-foot level extended west for about 1,000 feet and about 750 feet to the east. The dike was mined mainly above the 100-foot level within a length of more than 3,000 feet.

G. T. Gadsden, Utica, Mont., manager for the Syndicate, estimated that approximately 200,000 tons of dike material was mined and washed during the 32 years the mine was operated (2). The softer dike material near the surface is reported to have contained 60 to 75 carats of sapphire per cubic yard (28). Clabaugh (2) estimates that approximately 13,000,000 carats of sapphire was recovered during the Syndicate's operation. About 15 percent by weight was gem-quality stones; they represented about 75 percent of the total value. Some of the larger, rough, gem-quality sapphires weighed 11 to 12 carats, some of which weighed as much as 5 to 6 carats after cutting. The Yogo gem sapphires have a beautiful cornflower-blue color and high brilliancy after cutting. They have been considered to be superior in these respects to foreign sapphires. As early as 1901, these cut sapphires were selling at $30 to $40 a carat.

Weed (28) reported in 1898 that the price of rough, uncut, gem-quality stones in London ranged from $2 to $15 a carat, according to weight, color, and purity. The average price was $6 per carat for selected stones, $1.25 per carat for seconds, and $0.25 per carat for "culls" used for watch jewels.

Aitken (1) reported that the production of sapphire by the New Mines Sapphire Syndicate from 1924 to 1927, inclusive, amounted to 903,685 carats valued at $86,562. Of this total, 150,365 carats valued at $73,039 were of gem quality; 753,320 carats valued at $13,523 were for industrial and abrasive purposes.

The sapphire occurs in a minette or lamprophyre dike that cuts flat-lying Madison limestone. The dike strikes N. 56° E. and dips nearly vertical. It has been traced from Yogo Gulch northeastward for a distance of about 5 miles. Weathering has caused the decomposition and softening of the dike rock to a yellowish, friable, earthy, and clayey material. This decomposition continues irregularly to depths of about 60 feet below the surface. The underlying dike rock down to about the 100-foot level has been less affected by weathering, but, after being mined and permitted to weather a while, most of it can be disintegrated and washed. The dike rock in the lower levels as well as at some places nearer to the surface is hard and not weathered; it is refractory to treatment.

The New Mine Sapphire Syndicate, including its American Sapphire mine, owns 33 patented claims along the sapphire-bearing dike. When visited in 1948, the shaft house, boiler house, and numerous other buildings at the New Mine Sapphire mine were in fair condition but in general would require repairs. Most of the equipment is old and would not be suitable for efficient operation. Considerable hard dike material remains on the weathering platforms and in their vicinity.

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American Sapphire

The American Sapphire mine is about 2 miles southwest of the New Mine Sapphire Syndicate mine. It is on Yogo Creek about three-eights mile below a narrow gorge between the limestone cliffs known as the "Toll Gate."

The Fourth of July claim on the sapphire-bearing dike was located by Burke and Sweeney on July 4, 1896 (23). It was purchased from the locators by the American Sapphire Co. The Yogo Lapidary Co. operated the mine from 1904 until 1909; it then was acquired by the Yogo American Sapphire Co. (7). This company sold the property to the New Mine Sapphire Syndicate, the present owners, in August 1914 for a reputed price of $80,000 (19). The Syndicate closed the mine immediately; it has remained idle.

The first sapphire mining was done along the surface of the dike according to simple placer mining methods. A 40-foot and a 50-foot adit crosscut were driven to the dike in 1904. Drifts 125 feet and 200 feet long were driven from these crosscuts (4). Subsequently, a 300-foot shaft was sunk near the portal of the lower adit (25). Drifts were driven east and west on three shaft levels. A 100-ton treatment plant was constructed at a reported cost of $30,000.

The sapphire-bearing dike mined at the American Sapphire mine is at the west end of the same dike mined by the New Mines Sapphire Syndicate. The size and character of the dike, the sapphire occurrence, the character and quality of the sapphire, are about the same at both mines. The treatment of the sapphire-bearing material mined at the American Sapphire mine, however, differed radically.

The weathered, softer, and more friable dike material as mined was taken directly to the treatment plant, where it was passed through a 4-inch grizzly to a jaw crusher. The crushed material was screened and sized to three-fourths inch, three-eights inch, and 6 mesh. The sized material was treated in separate sets of Woodbury jigs. Capacity of the jigs was 75 tons per 7-1/2-hour shift. The jig concentrates, averaging 5 to 10 percent sapphire, were treated in Blake-Morscher electrostatic machines. The final concentrates from these separators contained 50 to 90 percent sapphire. Final cleaning and sorting was done by hand. The harder, less weathered dike material was subjected to weathering and disintegration before it was milled. The treatment plant recovered daily about 500 carats of salable gem-quality sapphire having an average value of $2 a carat (5).

Two sapphire gem cutters were employed at the mine in 1903 (4). A gem sapphire-cutting plant began operation in Great Falls, Mont., on October 22, 1906 (5). All of the gem-quality and the industrial-grade sapphire produced from the American Sapphire mine was marketed in the United States.

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The value of the sapphire produced up to 1904 is reported to have been about $30,000 (4). Production in 1906 was estimated to have had a value of about $250,000. Approximately 100,000 carats of gem-quality sapphire is reported to have been produced between April and December 1907 (19). According to Clabaugh (2), total sapphire production from the American Sapphire mines was less than 3,000,000 carats.

When visited in 1948, the mill building, still containing much of its equipment, was in bad condition. The shaft head frame and the ore bins had collapsed and fallen into the shaft, which itself was caved around the collar. The adits were inaccessible.

Gypsum

Gypsum formerly was mined from an open cut in a deposit in sec. 5, T. 16 N., R. 8 E., near the old Kebbey Post Office about 8 miles south of Raynesford. In 1898 the Aluminum Plaster Co. began crushing and calcining this gypsum in its plant about one-eight mile east of the present Kibbey schoolhouse. The plaster produced was marketed mainly in Great Falls, Mont., and in Spokane and Seattle, Wash. The plant was destroyed by fire in 1900 (29); it was not rebuilt. The company then moved to a new site on Belt Creek near Goodman, in Cascade County, about 8 miles south of Armington (14). The company's operation there continued for a short time only.

In 1910, the Montana Hardwall Plaster Co. mined gypsum from an open pit about 1 mile west of Kibbey, on the Fred Remington ranch in sec. 7, T. 18 N., R. 8 E. The gypsum rock was hauled to a crushing and calcining plant near Monarch, about 7 miles to the west. The plaster produced was marketed mainly in Great Falls. Operations were discontinued after producing only a small amount of plaster (14). The analysis of a Bureau of Mines sample taken across a thickness of 7 feet of gypsum exposed in the side of the old open pit showed the sample to contain 32.6 percent CaO, 40.8 percent SO_3, 0.15 percent insoluble, and 19.6 percent H_2O.

Two extensive deposits of gypsum occur in the valley of Lone Tree Creek 6 and 9 miles, respectively, south of Geyser. One of the deposits is on the J. W. Sisson ranch in secs. 3 and 10, T. 16 N., R. 10 E. The deposit, where exposed, is about 15 feet thick; it dips about 10°N. It extends for nearly 1 mile along the foothills on the east side of the valley. The deposit has not been explored. The other deposit is in secs. 20 and 21, T. 16 N., R. 10 E. on what is known as the B & M gypsum placer claim. It is about 3 miles south of the Sisson ranch deposit. Four or five beds of gypsum outcrop along the hillside north of Wolf Butte for a distance of more than 1,000 feet. These beds, as exposed, range from 2 to 20 feet in thickness. They are interbedded with shaly limestone; they strike N. 45° E. and dip 15° to 20° SE. Several trenches and open cuts have been excavated across some of the gypsum beds. An analysis of a Bureau of Mines sample cut across a 14-foot thickness exposed in one trench showed the sample to contain 32.7 percent CaO, 1.13 percent CO_2, 44.5 percent SO_3, 0.5 percent SiO_2, 0.28 percent MgO, 0.15 percent Fe_2O_3, 0.01 percent NaCl, and 19.8 percent H_2O. According to

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J.W. Sisson, Geyser, Mont., the mineral rights to the Wolf Butte deposits are held by F. W. Ruzicka, H. R. Trimmer, and E. Martin, Lewistown, Mont.

Another deposit of gypsum occurs in sec. 34, T. 14 N., R. 11 E., on the eastern side of the Little Belt Mountains, about 11 miles west of Utica. This area is known locally as Pig Eye Basin. The deposit is on deeded land owned by Harley and Earl Neel, Utica, Mont. Two beds of gypsum occur interbedded with sandy shale. The beds strike N. 25° W. and dip about 10° NE. One bed is about 15 feet thick. The other bed has not been exposed sufficiently to indicate its thickness or extent. The first bed has been explored by a 12-foot test pit. The analysis of a Bureau of Mines sample cut from the side of this test pit showed it to contain 33.0 percent CaO, 45.9 percent SO_3, 0.27 percent CO_2, 0.14 percent SiO_2, 0.07 percent MgO, 0.11 percent Fe_2O_3, 0.01 percent NaCl, and 20.2 percent H_2O.

The gypsum deposits formerly mined near Kibbey, the deposits in Pig Eye Basin, and those along Lone Tree Creek near Wolf Butte occur in the upper Kibbey formation, which is the lower member of the upper Mississippian strata (14). The Kibbey formation consists of 150 to 200 feet of sandy shales and sandstones characterized by bright red colors. The deposit at the Sisson ranch occurs in the upper part of the Otter formation that overlies the Kibbey formation. The Otter formation consists of 200 to 300 feet of gray shales, which are interbedded with green shales and thin beds of sandstone and limestone. The Kibbey and Otter formations overlie the Madison limestone formation, which forms the basal member of the Mississippian strata (14).

Limestone

Limestone formerly was burned at a kiln in Limestone Canyon east of Kibbey. The lime produced was used for local construction. No lime is known to have been produced in this area in recent years. A small amount of limestone was quarried at one time for use in the old smelter near the Woodhurst and Mortson mine on Running Wolf Creek. Massive limestone suitable for building stone occurs at many places along the eastern slopes of the Little Belt Mountains.

Bentonite

Bentonite occurs in sec. 6, T. 10 N., R. 12 E., about 2 miles west of Stanford, Mont., on land owned by Frank Kolar, Stanford, Mont. The deposit occurs in Colorado shales (27); it outcrops near the top and along the eastern slopes of the low hills about 1 mile north of the main highway west of Stanford. This deposit has been leased to Hall Brothers, contractors, Stanford, Mont.

Another extensive deposit of bentonite outcrops in secs. 20, 21, 22, and 23, T. 18 N., R. 10 E., along the edge of the bench north of Arrow Creek, about 4 miles north of Geyser. The deposit is on land owned by A. L. Kolar and sons, Stanford, Mont. The deposit has been exposed by bulldozer trenches cut at intervals over a distance of more than 1-1/2

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miles. The bentonite occurs between Colorado (Cretaceous) shale and sandstone as a nearly flat-lying bed 6 to 10 feet in thickness. The deposit generally is blanketed with overburden 2 to 20 feet thick; in places it has been cut by shallow erosion channels. A small amount of bentonite has been utilized locally for lining irrigation ditches and reservoirs. None of it has been processed or shipped.

Mica and Beryl

The quartz cores of several pegmatite masses in Archean (26) hornblende schist outcrop on the San Miguel group of mining claims in the San Miguel district. The trend of the pegmatite outcrops is northwest. Exposures are not sufficient to indicate the extent or attitude of the deposits. One trench has been excavated in the bottom of a small gulch that cuts across a pegmatite outcrop about one-quarter of a mile southwest of the San Marcos adit. Books of mica as large as 2 inches wide occur in the pegmatite exposed in this trench. Books of this mica are reported to have been sent to the Colonial Mica Corp. at Custer, S. Dak., in 1944, by T. J. Vaughn-Rhys, manager of the Faith Mining Co., which owns the San Miguel group of claims. The samples submitted were reported to be of good quality (18). Beryl also is reported to occur in this pegmatite mass.

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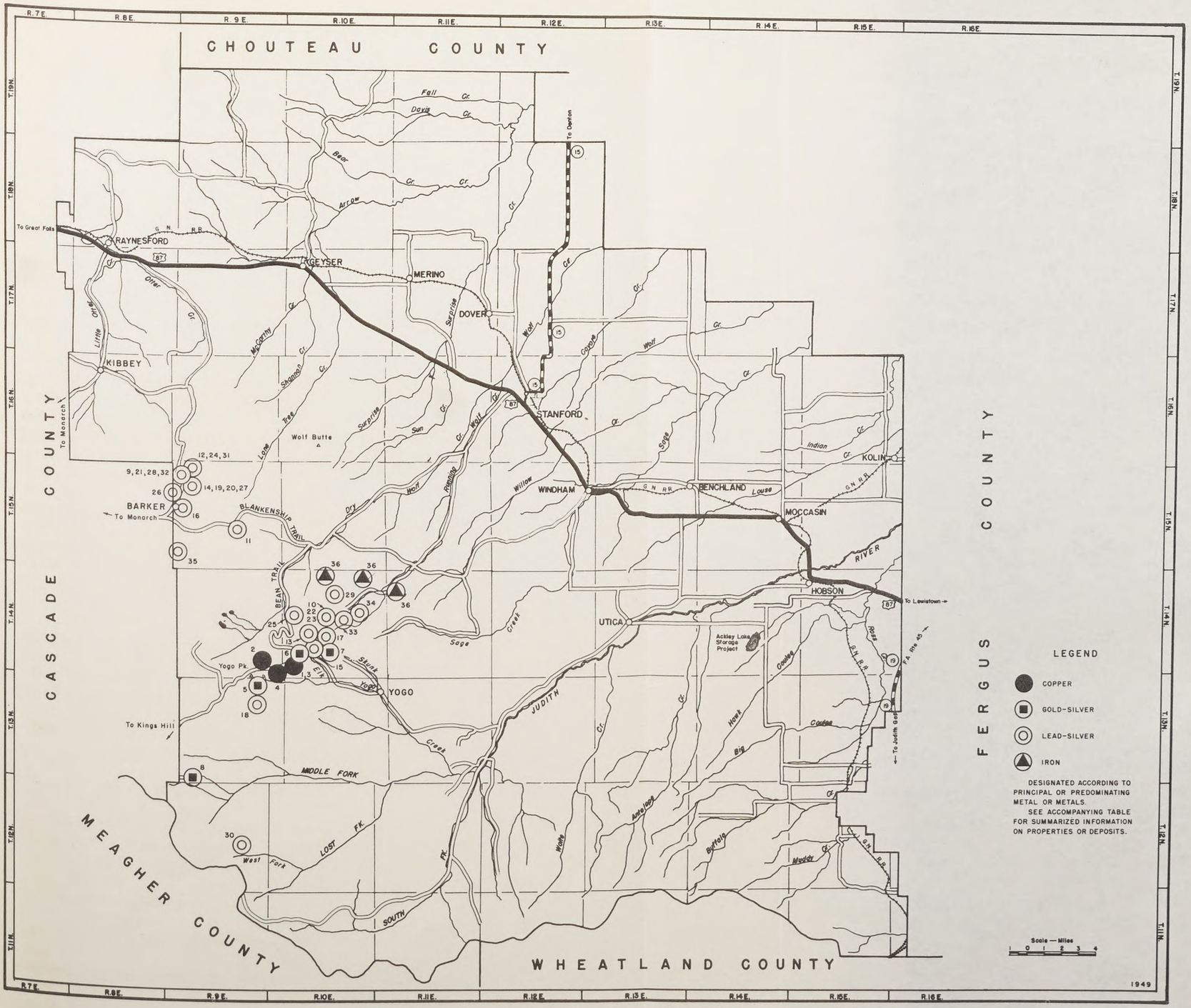

Figure 7.—Mineral Industry Survey map, Judith Basin County, Mont.

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MINERAL INDUSTRY SURVEY TABLE
JUDITH BASIN COUNTY, MONT., 1949
Metallic Mineral Deposits 1/

Map ref. no.	Name of property or deposit 2/	Location Sec.	Twp.	R.	Description of deposit	Indicated metal content	Reported production	Remarks
					● - Copper			
1	Blue Dick	30,31	14N.	10 E.	Contact metamorphic deposit at or near limestone-syenite porphyry contact. Magnetite, auriferous pyrite, chalcopyrite; small amounts scheelite and molybdenite.	702 tons averaged 0.47 oz. Au, 4.6 oz. Ag, 1.7% Cu a ton.	1937-46 - 702 tons ore. No early records.	Two adits and an open cut. 700 to 800 feet of development. 1,400-foot inclined-rail tramway to small flotation mill. Lower adit accessible.
2	Finlander	25,26 35,36	14N.	9E.	Contact metamorphic deposit at or near limestone-syenite porphyry contact. Magnetite with small amounts of pyrite and chalcopyrite.	?	None of record.	600-foot adit and 96-foot shaft on north slope of Yogo Peak. Workings now inaccessible.
3	New Deal	30	14N.	10E.	Contact metamorphic deposit at or near limestone-syenite porphyry contact. Magnetite, pyrite, and chalcopyrite. Contains gold and silver.	?	None of record.	Six adits of unknown lengths. Formerly had a small gravity type mill. Four of the adits inaccessible. Two adits partly accessible.
4	Sarsfield	36 31	14N. 14 N.	9E. 10E.	Contact metamorphic deposits at or near limestone-syenite porphyry contact. Magnetite, pyrite, chalcopyrite, copper oxides, and carbonates, and a small amount of scheelite.	Sample of ore from 60-foot level of shaft assayed: 0.035 oz. Au, 0.25 oz. Ag, 0.99% Cu, and 0.01% WO_3.	Some ore reported to have been shipped. Record of metal content not known.	450-foot adit crosscut, 50-foot adit, and 70-foot shaft with about 100 feet of drifts. Both adits accessible. Shaft workings now inaccessible.
					◉ - Gold-Silver			
5	Bourke-Larson	2	13N.	9E.	Residual gold placer in decomposed syenite porphyry. A narrow quartz vein contains copper oxides and carbonates. A replacement deposit in limestone contains galena and cerussite.	?	None of record.	Water brought to residual placer through 4,000 feet of 4-inch pipe. Used one afternoon and 8 oz. of gold recovered.
6	California (Harriet)	30	14N.	10E.	Ore deposits in altered limestone adjacent to narrow basic dike. Altered zones contain small amounts of galena, cerussite, limonite, copper oxides, and carbonates.	Selected samples from adit dump assayed 0.05 to 1.0% Pb, 0.05% Zn, 0.01 oz. Au, and a trace Ag.	A small amount of gold ore reported to have been mined during early days.	150-foot adit connects with bottom of a 50-foot shaft. Adit accessible. Shaft inaccessible.
7	Gold Bug (Weatherwax)	29	14N.	10E.	Pyrite with minor amounts of chalcopyrite, copper oxides, and carbonates in limestone overlying syenite porphyry. Free gold in oxidized zone. Auriferous pyrite at depth.	Averages: 0.23 to 0.74 oz. Au, 0.37 to 6.6 oz. Ag, 0.77 to 3.96% Cu.	No record of early production. 1937-46 - 508.52 tons sorted ore shipped.	Three adits, a shallow shaft, and several open cuts. About 1,200 feet of development. Only two adits accessible. Shafts caved. Last operated in 1946.
8	Weatherwax and King (Lenny)	31	13N.	9E.	Pipe or chimney of limonite and hematite containing gold and silver in limestone near contact with syenite porphyry.	Selected ore on dump: 0.05 oz. Ag, 0.005 oz. Au, 0.05% Pb, 50.7% Fe.	No records available.	Two shafts, 150 and 20 feet deep. One long adit and several short adits. Ore treated in an arrastre in early days. All workings now inaccessible.
					◎ - Lead-Silver			
9	Block P (Barker, Wright and Edwards)	6	15N.	9E.	Ore in fissure veins in syenite that intruded earlier granite porphyry; ore also in vein along contact of the syenite with granite porphyry. Galena, sphalerite, marmatite, pyrite, chalcopyrite, and tetrahedrite in gangue of quartz, rhodochrosite, barite, and calcite.	Averaged 9.0 oz. Ag, 6.0% Pb, 5.0 % Zn, 0.03% Cu in 1929.	Largest producer in the county. No records available of production prior to 1915. Production 1915 to 1948, incl., 405,852 tons ore yielding 3,332.13 oz. Au, 2,578,224 oz. Ag, 775,112 lb. Cu, 42,750,417 lb. Pb, 17,848,398 lb. Zn.	1,484-foot Barker shaft, 320-foot W. and E. shaft, more than 20,000 feet of adits, drifts, and crosscuts. Some mine workings accessible above collar of Barker shaft. Lower workings flooded. Lessees operated in old upper levels during 1949.
10	Bessie (Seiden)	16	14N.	10E.	Narrow quartz vein containing pyrite and galena cutting across bedding planes of limestone.	?	None reported.	Many short shallow adits and open cuts. All but two short adits are inaccessible.

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MINERAL INDUSTRY SURVEY TABLE
JUDITH BASIN COUNTY, MONT., 1949
Metallic Mineral Deposits 1/ (Contd.)

Map ref. no.	Name of property or deposit 2/	Location Sec.	Twp.	R.	Description of deposit	Indicated metal content	Reported production	Remarks
					◎ - Lead-Silver (Contd.)			
11	Blankenship	22	15N.	9E.	Replacement deposits in limestone. Ore is mainly cerussite and galena in quartz gangue.	?	One carload shipped in 1927.	Three adits from 50 to 300 feet in length. Also an inclined shaft of unknown depth. About 1,000 feet of development. Incline, two of the adits, and some drifts accessible in 1948.
12	Carter	6	15N.	9E.	Replacement deposits occurring mainly in a pipe or chimney in limestone near contact with syenite or granite porphyry. Galena, cerussite, sphalerite, marmatite, and pyrite.	?	No production records available.	220-foot two-compartment shaft and a 700-foot adit crosscut with several short drifts. Adit and some drifts accessible. Shaft caved and inaccessible.
13	Christopher Columbus	20	14N.	10E.	Galena and cerussite in altered limestone on both sides of a narrow basic dike near porphyry contact. Altered limestone also contains small amounts of copper oxides and carbonates, iron and manganese oxides.	?	Two tons reported to have been shipped in 1901.	745-foot adit, 90-foot, 110-foot, and 80-foot shafts, several open cuts. Adit caved at portal. Shafts caved and inaccessible.
14	Dockter Kalloch	6,7	15N.	9E.	Veins along syenite porphyry-rhyolite porphyry contact. Galena, sphalerite, marmatite, and pyrite in quartz, calcite and rhodochrosite gangue. The ore contains silver and some gold.	Sorted ore shipped 0.003 oz. Au, 30 oz. Ag, 0.01% Cu, 24% Pb, 1.6% Zn.	1917-43, incl., 133 tons ore shipped. 0.39 oz. Au, 4,004 oz. Ag, 43 lb. Cu, 63,156 lb. Pb and 4,143 lb. Zn recovered.	Two adits of unknown lengths. Inaccessible.
15	Della and Quaker City	30	14N.	10E.	2- to 3-inch band of altered limestone at contact with minette dike containing free gold and small amount of lead minerals.	?	None reported.	40-foot shaft and several adits.
16	Forest (Lilly)	18	15N.	9E.	2- to 4-foot fissure vein cuts granite porphyry and shaly limestone. Vein contains pyrite with small amounts of galena.	?	None reported.	14-foot shaft, a 30-foot adit, and several open cuts. All workings now inaccessible.
17	Hans Setter	21	14N.	10E.	Replacement deposits in limestone near syenite-porphyry contact. Argentiferous galena, sphalerite, and pyrite.	?	Seven tons of ore, sorted from old dumps, shipped in 1937.	Several open cuts and near surface adits. Inaccessible.
18	Leonard	11	13N.	9E.	Replacement deposit in limestone at contact with syenite porphyry dike. 8 to 15 inches of silicified limestone contains galena, pyrite and small amount of sphalerite.	Selected sample: 0.005 oz. Au, 83.6 oz. Ag, 22.9% Pb, 0.1% Zn.	No production.	Short adit and one open cut. Adit being driven in August 1949.
19	Liberty	6,7,8	15N.	9E.	3- to 4-foot vein in syenite near contact with granite porphyry. Galena, sphalerite, marmatite, pyrite, chalcopyrite and tetrahedrite in quartz, calcite and rhodochrosite gangue. Silver with small amounts of gold, cadmium, arsenic and antimony.	0.035 oz. Au, 11 oz. Ag, 6.5% Pb, 10.0% Zn.	No records of early production available. 2,957 tons ore 1913 to 1947 yielded 102.61 oz. Au, 70,808 oz. Ag, 13,313 lb. Cu, 1,531,332 lb. Pb and 75,366 lb. Zn.	Several adits and a 190-foot inclined shaft on Liberty claim. Other adits on adjoining claims. Over 100,000 tons of indicated ore reported. 4,500 tons milling grade ore on dump. Most of the adit workings accessible in 1949.
20	Magnolia and St. Louis	7	15N.	9E.	Replacement deposits along or near a limestone-granite porphyry contact. Argentiferous galena, sphalerite and pyrite. Average width about 3 feet.	44% Pb, 20% Zn, 37 oz. Ag, a ton.	A few thousand tons from St. Louis. A small tonnage of ore from Magnolia. No data on metal content.	St. Louis had 200-foot adit and Magnolia a 150-foot adit in 1897. The St. Louis adit was inaccessible in 1944. The Magnolia adit was accessible.
21	May and Edna	1 6	15N. 15N.	8E. 9E.	Replacement deposits along or near a limestone-rhyolite porphyry contact. Argentiferous galena, sphalerite, pyrite and a small amount of chalcopyrite in quartz and calcite gangue.	?	Reported as two of principal producers in early days. No records available.	700-foot main adit and several pits and open cuts. All workings inaccessible.
22	Mountainside and Last Chance	16	14N.	10E.	Replacement deposits along or near contact of limestone and overlying minette sheet.	?	Some high-grade ore reported mined many years ago.	Three adits. Only one adit accessible.
23	Oscar Helsing	16	14N.	10E.	Replacements in limestone near syenite contact. Galena, cerussite, iron oxides, quartz and calcite.	?	None of record. A small amount of ore milled.	Several adits, shallow shafts, and open cuts, all inaccessible. At one time had small mill.

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MINERAL INDUSTRY SURVEY TABLE
JUDITH BASIN COUNTY, MONT., 1949
Metallic Mineral Deposits 1/ (Contd.)

Map ref. no.	Name of property or deposit 2/	Location Sec.	Twp.	R.	Description of deposit	Indicated metal content	Reported production	Remarks
					◎ - Lead-Silver (Contd.)			
24	Paragon	6	15N.	9E.	Replacement deposits in limestone near porphyry contact. Galena, cerussite, sphalerite, marmatite, pyrite.	?	No records available. Some good ore reported to have been mined and shipped in early days.	150-foot shaft and several hundred feet of drifts. Inaccessible.
25	Pierce-Higbee (Dry Wolf)	18	14N.	10E.	Replacement deposits in brecciated limestone. Galena, cerussite, pyrite, small amount of chalcopyrite.	?	None of record. Some ore reported to have been shipped in early days.	Several shallow adits. Inaccessible.
26	Pride of the West	12 7	15N. 15N.	8E. 9E.	Replacement deposits in limestone at or near granite porphyry contact. Argentiferous galena.	13 sacks reported to have assayed 220 oz. Ag a ton.	Ten tons reported shipped in 1889 said to have netted $87 a ton.	Several short adits. Inaccessible.
27	Queen Esther	6	15N.	9E.	Vein on contact of syenite and granite porphyry. Contains narrow streak of galena.	?	Four carloads reported shipped to 1889. Grade not known.	Had two adits aggregating 170 feet in 1897. May have been patented as Queen of the Hills claim.
28	Silver Gulch	6	15N.	9E.	No information regarding deposit.	?	None of record. Some ore reported to have been mined in 1892.	Extent of development not learned.
29	Sir Walter Scott and Mystery	9,10	14N.	10E.	Flat-lying replacement deposit in limestone containing malachite, azurite, cerussite, smithsonite, silver bromide and chloride, fluorite, quartz, and calcite. Also a vein at limestone-syenite porphyry contact reported 2 to 5 feet wide.	Selected ore: 0.02 oz. Au, 65.5 oz. Ag, 0.05% Pb.	No early records. 1948: 12 tons. 253 oz. Ag, 102 lb. Cu, 164 lb. Pb, 240 lb. Zn.	300-foot shaft, 75-foot inclined shaft, several small open cuts. Underground workings inaccessible. Road built to property in 1948.
30	Sweepstakes	23	12N.	9E.	Nodules and small masses of cerussite and galena irregularly distributed as float in soft yellow shaly limestone.	?	308-pound sample shipment assayed 0.01 oz. Au, 114.2 oz. Ag, 59.7% Pb, and 0.05% Cu.	20-foot shaft and 300-foot adit. Adit driven through loose blocks of limestone and surface debris, partly accessible. Shaft inaccessible. No ore found in place.
31	Tiger, Moulton and T.W.	5,6	15N.	9E.	Main vein 3 to 6 feet wide in Barker porphyry along contact of two varieties of porphyry. Also replacement deposits along a porphyry-limestone contact. Argentiferous galena, cerussite, sphalerite, pyrite, smithsonite in quartz, rhodochrosite, calcite gangue.	30 to 40% Pb, 18 to 40 oz. Ag. Some high grade.	1,000 tons from Tiger 1893-1898. 3,000 tons from Moulton in 1898. 400 tons from T.W. before 1892.	Most development done in early days. Tiger - shaft 230 feet, adit 550 feet; Moulton - shaft 100 feet, adit 1,232 feet; T.W. - shaft 140 feet, adit 430 feet. Only T.W. adit open in 1948.
32	Top Hand	6	15N.	9E.	Flat-lying deposit, probably along limestone-porphyry contact. No information available.	?	No details. Ore reported to have been mined and shipped prior to 1892.	Reported to have had a 400-foot adit when operated by Paragon Mining Co. in 1892.
33	Woodhurst and Mortson	15	14N.	10E.	Contact replacement deposit, 2 to 7 feet wide, between limestone and syenite porphyry. Galena, cerussite and pyrite in silicified limestone gangue.	Some high-grade lead carbonate ore mined in early days.	No early records. 1898 production reported to have been 500 tons containing 65% Pb and 30 oz. Ag a ton.	250-foot shaft and 4,000 feet of levels. Had small smelter. Smelter removed long ago. Workings inaccessible.
34	Yankee Girl	14	14N.	10E.	Replacement deposits in limestone. Galena and cerussite with small amounts of sphalerite and smithsonite. Gangue is jasper and calcite.	Some high-grade galena ore mined in early days.	Two tons shipped in 1932 contained 16 oz. Ag a ton, 44% Pb and 3.4% Zn. No data on other production.	100-foot inclined shaft and several open cuts and short adits. Incline accessible for about 75 feet. Considerable ore in old dumps.
35	San Miguel	25,36 30,31	15N. 15N.	8E. 9E.	Irregular deposits along bleached zones in hornblende schist contain scattered cyrstals of galena and sphalerite.	Shipment reported Au-0.70 oz., Ag-180 oz., Pb-51.0% Zn-3.0%.	One car shipped in 1927.	Eleven adits reported to range in length from 50-500 feet. Several shallow shafts. Only 2 adits accessible in 1948.
					▲ - Iron			
36	Running Wolf Iron	2,4 7	14N. 14N.	10E. 11E.	Replacement deposits in Madison limestone along syenite porphyry contact. Fine-grained, intimate mixture of magnetite and hematite with minor amounts of limonite. Lenses of iron ore averaging 5 to 15 feet in width occur at intervals along the contact within distance of about 6 miles.	Average, 2 lenses 58.75% Fe, 0.109% S, 0.02% P, less than 0.01% TiO_2.	No ore shipped.	Eastern 4,000 feet of the contact investigated by U.S. Bureau of Mines in 1943-44. Two lenses of ore partly delimited by 28 trenches and 4 core drill holes.

1/ Classified according to predominating metal or metals.
2/ Also known by name shown in parentheses.

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Interior - Bureau of Mines, Pittsburgh, Pa.

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